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Effects of Computer-Displayed Dynamic and Static Visuals on Achievement, Immediate Recall, Time, and Confidence in Visual Authoring

by

Ronald G. Schlender

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Education.

in

Instructional Technology

Department of Adult Career and Technology Education

Edmonton, Alberta

Fall 1995

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CURRY SCHOOL OF EDUCATION
DEPARTMENT OF EDUCATIONAL STUDIES

June 21, 1995

Ron Schlender
28 Lucerene Crescent
St. Albert, Alberta
Canada T8N 2R2

Dear Mr. Schlender:

In response to your letter, I am enclosing a copy of our survey of attitudes towards computers.

The survey is scored according to the following:

- **For questions** 1, 3, 4, 6, 9, 11, 12, 14, 16, 17, 19, 22, 25, 27, 28, 30, 33, 35, 36, 38 (Strongly Agree=4, Slightly Agree=3, Slightly Disagree=2, Strongly Disagree=1).
- **For questions** 2, 5, 7, 8, 10, 13, 15, 18, 20, 21, 23, 24, 26, 29, 31, 32, 34, 37, 39, 40 (Strongly Agree=1, Slightly Agree=2, Slightly Disagree=3, Strongly Disagree=4).

The questions are coded so that the higher the score, the more positive the attitude.

Four subscores can also be obtained from the questions.

Anxiety:	1, 5, 9, 13, 17, 21, 25, 29, 33, 37
Confidence:	2, 6, 10, 14, 18, 22, 26, 30, 34, 38
Liking:	3, 7, 11, 15, 19, 23, 27, 31, 35, 39
Usefulness:	4, 8, 12, 16, 20, 24, 28, 32, 36, 40

Again, higher scores correspond to more positive attitude, e.g., a higher confidence score means more confidence and a higher anxiety score means *less* anxiety.

If you need any additional information about the scale, please contact me. Permission is granted for use of this scale.

Sincerely,

Brenda H. Loyd

Brenda H. Loyd
Professor

Enclosure

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October 2, 1995

Abstract

The purpose of this study was to examine the effects of static and dynamic visuals in a computer based instruction delivery model designed to help the user create a program in Authorware Professional™ for MacIntosh that resulted in a computer generated title page. Two versions of the computer based instruction were developed, one containing textual instructions supported by static visuals and the other containing the same textual instructions supported by dynamic visuals. The dependent variables examined were successful completion of the task, immediate recall of learning, time taken in completing the task, and computer confidence of the user.

Sixty-two students from grades nine to twelve were involved in the study. In this study no significant difference was found between the two treatment groups on any of the four dependent variables. Suggestions for further study along with modifications to existing study are discussed.

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled EFFECTS OF COMPUTER-DISPLAYED DYNAMIC AND STATIC VISUALS ON ACHIEVEMENT, IMMEDIATE RECALL, TIME, AND CONFIDENCE IN VISUAL AUTHORING submitted by RONALD G. SCHLENDER in partial fulfillment of the requirements for the degree of MASTER OF EDUCATION in INSTRUCTIONAL TECHNOLOGY.

Michael Szabo
Dr. Mike Szabo

D Engel
Dr. Douglas Engel

Dr. Milton Petruk

J Collett
Dr. Dave J. Collett

September 14, 1995

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List of Symbols, Nomenclature and Abbreviations

APM (Authorware Professional™ for MacIntosh) The software package used to create the learning task for the study.

CBI (Computer Based Instruction) Operationally defined as the style of instructional delivery for this study in which the subject receives instruction via the computer only.

Chunking Breaking down a frame of instruction into its component "chunks" (a chunk contains only text or only static graphics or only animated graphics)

DVD (Dynamic Visual Displays) The presentation of any type of pictorial and graphical movement during insturction.

SVD (Static Visual Displays) Still pictorial images that do not change over time.

Chapter I

Overview of the Problem

Historical Background

As human beings came together to form societies they developed technologies to support, expand, and express their existence. See (1994) identifies four major inventions in the area of human expression that have had significant impact on mankind. The first was language, which allowed society to share experiences. The second was the alphabet, which allowed society to record experiences. The third was the printing press, which allowed society to widely share experiences. The fourth major invention, he says, is the computer. It has the potential to allow society to access electronic experiences at any time, in any place, and in numerous formats. The new possibilities generated by multiple formats provide both opportunities and topics to explore for users and researchers alike.

The human race has always had a basic need to communicate. Unlike other animals with the same need, humans created technologies to improve the quality of communication and satisfy that basic need. As the quality of technology has improved, so has the quality of communication. Conversely, as the need for improved communication has increased, so has the need for improved technologies to fulfill the need.

Postman (1993) cautions society about the use of technology, warning against technology's ability not to serve the human race, but to reshape and control it. He suggests that technology, rather than humans, define the communication. Molek (1984), speaking more positively about the use of technology, points out that technology has been related to, and a driving force of, literacy. He states, "the improvements in literacy technology seem to focus on two factors: making it easier to create and to transport messages" (p. 8). A recent technology in an evolutionary communication process is the computer. The computer and its related technologies have raised human expression to a new level as evidenced by the "information highway", interactive information providers, digitization, compression, static and dynamic visuals, etc. The potentials to significantly change the format of human expression are only beginning to be realized.

As researchers study the potential of the computer and its capacity to create visual and interactive communications, society is already making its decision both on its desire for this form of communication technology, and the computer's capacity to transmit information. This is evidenced by the growth of billion dollar companies such as Sega and Nintendo. As one researcher (Stredney, 1982) points out "the speed at which the recent craze for video games has grown is phenomenal. It is apparent that people are willing to spend millions of dollars in quarters and stand for hours in front of a video game" (p. 49). This phenomenon does not seem to be leveling off. The appetite for some type of dynamic visual communication appears to be increasing as the power of the technology increases.

One of the reasons for this phenomenal growth, Stredney suggests, is that although we live in a three-dimensional world, we are often taught spatial-tactile subject matter through textbooks and lectures. Computer technology increasingly has the ability to create visuals that more closely approximate the three-dimensional world we function within. Molek (1984) also highlights the power of the computer and related technologies to impact visual communication:

> Electronic technologies have begun to create tools which not only reproduce visuals, but which allow for the creation and the control of visual forms, These new developments are affecting not only what the general public learns from looking at visuals, but how they will eventually communicate, learn, and think with visuals. (p. 8)

Introduction of the Problem

One of the most widely practiced forms of communication in organized society is instruction. It too is beginning to be massively influenced by the computer/communication revolution. One new format that the computer provides for communication is the improved use and flexibility of visuals.

See (1994) claims that computers are ushering in the Fourth Information Revolution and will have significant impact on learning delivery systems:

> There is no doubt in my mind that the Fourth Information Revolution is changing the role and responsibilities of people, including teachers, who were considered information professionals during the Industrial Age. Machines are becoming the information givers of our society. (p. 31)

Rieber (1988) echoes the same sentiments about the potential of computers to deliver instruction supported by visuals. "Animation is one such capability that can be more easily integrated into computerized instruction than other instructional systems" (p. 78).

Park and Hopkins (1993) classify instructional visuals as either dynamic or static. They define dynamic visual displays (DVD) as the presentation of any type of pictorial and graphical movement during instruction. DVDs include animation which is defined as a series of rapidly changing computer screen displays that present the illusion of movement. A static visual dispay (SVD) is characterized by no movement or object manipulation. For educational researchers, one of the challenges will be to explore the potential of visual communication and it's relation to learning.

Research suggests when using DVDs it is important to consider the appropriate use of the medium such as color, amount of visuals, and cueing techniques. Manipulation of these factors is important to behavorial learning. Behavorial learning tries "to accomplish two goals--to learn about the situation ... and to obtain success with the task at hand" (Glatthorn and Baron, 1991, p. 64). In the behavioristic paradigm, Park and Hopkins (1993) suggest that the functional significance of a visual variable is threefold:

> 1) it [serves] as a cue for the guiding and directing attention; 2) once attention has been obtained, it is assumed that an association between the narrated and visual components would cue the learner to the importance or significance of those portions of the instruction, and thereby, elicit implicit (verbal or perceptual) responses to it; and 3) these verbal and perceptual responses ... serve as cues in performance on an unprompted or terminal application. (p. 428)

In this study subjects were given a task to replicate and visuals were used to create an association between textual instructions and a visual understanding of the task to complete. Subjects are then assessed on their knowledge of the task and incidental learning.

Molek (1984) points out that, "the designer can focus the student's attention to specific details (both visual and verbal) by revealing the information when it is most appropriate" (p. 9). Reiber (1990) itemizes three recommendations when using animation (one form of DVD):

> Recommendation 1: Animation should be incorporated only when its attributes are congruent to the learning task. (p. 79)

> Recommendation 2: Evidence suggests that when learners are novices in the content area, they may not know how to attend to relevant cues or details provided by animation. Breaking down a frame of instruction into its component "chunks" of information so that each chunk (a chunk contains only text or only static graphics or only animated graphics) is displayed individually appeared to be a major contributing factor to finding differentiated effects between static and animated graphics. (p. 82)
>
> Recommendation 3: Animation's greatest contributions to CBI may lie in interactive graphic applications. (p. 83)

This study will incorporate suggestions for the effective use of dynamic visuals. These include appropriate use of visuals along with 'chunking' information and proper cueing for the learner. As Rieber (1991) points out, "Students attention to animation must be sufficiently cued and directed in order for potential learning effects derived from animation to be realized"(p. 7).

Most learners have traditionally been trained to learn in a print based-model. This is a result of the technology that was historically available to educators. The computer is a new technology that provides the educators with very different tools to aid in the learning process. The learner will need to be trained to learn within this medium and also educators will need to be trained in the proper use of these tools.

When reviewing the research in the area of dynamic visuals Reiber & Kini (1991) conclude "Animation research has focused on two fundamental applications of animation in CBI: 1) animation as a presentation strategy; and 2) practice activities involving interactive animated graphics"(p. 83). This study compares static and dynamic visuals used to support the presention of procedural instructions to create a title page. The subject read an instruction, and had the option of viewing, or not viewing, a visual to support the instruction. The subject then attempted to replicate the instruction in a computer workspace. The study is novel in that unlike exploring the computer's ability to teach a non-computer activity, it explored the computer's ability to teach a computer skill, specifically the development of an Authorware Professional™ program.

Dwyer (1978) presents factors that must be considered when studying CAI that incorporates the use of visuals.

> Two critical questions related to the effective and efficient use of visualization in the teaching-learning act: (a) when is it most desirable to incorporate visualization in the instructional presentation, and (b) after the decision has been made to utilize visualization, what kind of visualization should be used? (p. 50-51)

In this study the question of when to use the visual is left to the discretion of the learner. The learner is given control over when, and if, to view the visual, and makes the decision regarding when it is most desirable to incorporate a visual into the instruction. This is done through the use of 'hot buttons' that upon being activated, allow the learner to control the pace and frequency of accessing the visual. These 'hot buttons' allow the user to exercise learner control over whether and when the visual is used in the learning process.

As communication advances technology, and technology advances communication, the process of human expression will evolve into different formats. The inclusion of static and dynamic visuals with text along with varying degrees of learner control appears to be assuming a greater role in instruction. This evolving communication form creates increased need for research.

The fundamental question that this study seeks to explore is what kind of visualization (static or dynamic) is most effective for learning a procedural task. The type of visualization is examined by its effect on successful completion of the task, time spent, immediate knowledge acquired, and computer attitude.

Problem Statement and Research Questions

This study explores the ability of dynamic visual to improve learning when added to textual instructions. The study provided learners with textual instructions, supported by either static or dynamic visuals, and then assess the effect on learning. The task that the subjects were asked to master in this study was procedural in nature because it provided the subject with a set of instructions that when completed resulted in an electronic title page being produced.

The major question of this study is whether the use of text supported by dynamic visuals improves learners' ability to replicate a series of tasks presented by a computer when compared to text supported by static visuals. The subject was required to complete the tasks from memory, because the computer only allowed the subject to view the instruction, or to perform the task. The subject was free to switch between instruction and performance anytime, but was not able to view both at the same time. Specifically, when both dynamic and static visuals are supplements to text:

- Does the use of dynamic visual support increase scores evaluating successful replication of a procedural task when compared with static visual support?
- Does the use of dynamic visual support increase scores assessing immediate recall of knowledge acquired as a result of completing the procedural task when compared with static visual support?
- Does the use of dynamic visual support decrease the amount of time needed to learn and perform a procedural task when compared with static visual support?
- Does the use of dynamic visual support result in a higher degree of computer confidence by the user when compared with static visual support?

Computer technology has the ability to deliver both static and dynamic visuals to support text. If computer instructional designers choose to make use of these options, there should be relationships between their use and improved learning, given that the context of the learning is appropriate for their use, as suggested by Reiber (1990). If not, then their use must be questioned because of the increased difficulty of creating curriculum that incorporates visuals.

Some potential areas for improved learning that visual support can affect are the amount of time a learner takes to complete a task and the knowledge retained upon completion of the task. These two variables, along with learner attitude, are areas this study intends to explore. The null hypotheses proposed for this study are:

- There is no difference in performance scores replicating a procedural task when the instructions are supported by static or dynamic visuals.
- There is no difference in scores of static or dynamic visual supported groups on an assessment of immediate recall.
- There is no difference in static or dynamic visual support with respect to time spent learning and performing a task.
- There is no difference in computer confidence of users after learning and performing a procedural task that is supported by static or dynamic visuals.

Statement of Significance

The production of either static or dynamic visuals to support textual instructions is at least time consuming if not difficult. Much time and effort could be wasted if they are not used in a context where they have a positive effect on the learning. Both Baek & Layne (1988) and Poohkay (1994) conducted studies involving CBI and the three situations of text, text with static graphics, and text with animated graphics. Both studies found that text alone produced significantly lower results than the visual supported instruction. Coscarelli and Schwen (1979), on the other hand, conducted a study comparing prose, graphic flow charts and lists and found no significant difference between the three.

Computer technology is increasing in its ability to deliver computer based training that allows more control by the learner and dual-coding in the form of text and visuals. When discussing the use of visuals as being on a continuum between non-interactive and interactive use in learning a concept, Molek (1984) says,

> In the middle on this continuum (student use of visuals) is the instructional strategy where students control predesigned visuals in order to learn a concept or to communicate their understanding of a concept. This is where technology has made an impact and will be making an even greater difference in the use of visuals (p. 10).

Also Worthington and Szabo (1995) showed that interactive learner control in computer based instruction results in increased learning of aural skills in music theory.

This study explores two types of predesigned visuals (static and dynamic) as they relate to a procedural task. The user has control over the number of times he or she views the visual, including not at all, to learn the procedural task of replicating a title page. In Reiber's (1990) words, the learning is separated into "chunks" and the user has control over when and if to use the visual support. The subject demonstrates learning by replicating the task suggested after each chunk of learning as opposed to when all the chunks have been presented. The assessment of immediate recall is conducted as soon as the task is completed by having the user answer computer generated text questions supported by static or dynamic visuals, which is a consistent format as the presentation of learning

This study will help to add to the body of knowledge in the area of computer generated visuals because it explores which type of visual (static or dynamic) is more effective in learning a procedural task. Effectiveness is defined in terms of successful completion of the task, immediate recall, completion time, and computer attitude.

The whole field of computer use of visuals will expand because of the decreasing cost and increasing power of computers. Both of these factors will bring computer visuals into the mainstream of communication. Knowledge of proper use of this tool will have increasing significance.

Delimitations

Alesandrini (1984) discusses the expanse of the topic involving visuals which has many dimensions to it. The degree of complexity and abstraction, amount, or absence, of color, and the amount of user control over visual generation are just some of the concerns. This study will delimit certain aspects of visual investigation to make research possible. The study will only concern itself with representational or "realistic" visuals that share a physical resemblance with the thing or concept that the picture stands for. This excludes arbitrary pictures.

The visuals used in this study were exact duplicates of what they were supposed to represent. Abstraction was involved to some extent because although the visuals realistically represented what they were supposed to, the picture they replicated was an abstraction of a display or action. For example the interaction icon (?) although realistically represented is an abstraction of the concept of someone making a response based upon a CBI question.

The study included only monochrome pictures. This will help to focus the discussion on the visual elements excluding choice and complexity of color. Another reason for this delimitation is that the programming visuals that the study uses are naturally monochrome. Color may help to focus the learner on appropriate clues, but this would not be a "realistic" view, and hence be contrary to the first delimitation.

Edwards (1975) suggests an interesting finding regarding visuals that should encourage further investigation. She claims "even though students may learn more or may learn more quickly through CAI, there is some evidence that they may not retain as much as traditionally taught students" (p. 151). This claim suggests that investigation of visual effects on immediate recall and long term retention should occur. This study will delimit itself to the effect of visuals on immediate recall. It does not have the longitudinal structure to make any comments regarding long term memory.

This study focuses on whether, when a learner is asked to learn and replicate a procedural task, it is better to use static or dynamic visuals to aid in the successful completion of that task. It does not compare visually supported text with text alone. It also does not explore the question of whether visually supported text is the proper context for the learning involved. The question of whether visuals alone, or auditory instructions, or some other form of communication is more effective in supporting learning a procedural task is not explored.

Landa (1974) defines an algorithm as, "a precise, generally comprehensible prescription for carrying out a defined sequence of elementary operations in order to solve any poblem belonging to a certain class" (p. 11). The defined sequence for this study will be a set of programming steps to create a computer screen title page.

Assumptions

There are four major assumptions upon which the study's hypotheses are based.

- Random assignment of students to treatment provided an effective control for all known and unknown independent variables except those being manipulated.
- Subjects would have the sufficient time to complete the task.
- All individuals in each group would benefit equally from the textual instructions given to the group.

- Visuals have an influencing effect on the learning process.

Definition of Terms

Several terms and phrases used in this study are defined to promote clarity. These words will be defined operationally so as to fall within the framework of this research study.

APM™ - This code represents Authorware Professional™ for MacIntosh which is the software package used to create the learning task for the study.

Computer Animation is a series of rapidly changing computer screen displays that present the illusion of movement.

Computer Based Instruction (CBI) is operationally defined as the style of instructional delivery for this study in which the subject receives instruction via the computer only.

Computer Confidence is a dependent variable for this study and it refers to reported Likert Scale scores of subjects on a computer administered attitude survey given after the computer assisted instruction.

Dynamic Visual Displays (DVD) is the presentation of any type of pictorial and graphical movement during instruction.

Immediate Recall is the ability to remember specific and incidental information about the task immediately after the task is completed.

Learning is "... a change in human disposition or capability that persists over a period of time and is not simply ascribable to processes of growth." (Gagné, 1985, p. 6)

Learning Time is the amount of time, as measured by the computer, that the subject uses to read and understand the instructions, plus the time the subject uses to complete the procedural task.

QuickTime™ is an Apple Macintosh system extension that handles real-time synchronization of video, animation, graphics, and sound.

Static Visual Displays (SVD) are still pictorial images that do not change over time.

Successful Completion is the degree to which a subject can replicate the task outlined in the CBI instructions.

Chapter II

Review of the Literature

Introduction

As a communicating tool, the computer with its increasing power has the ability to display visuals along with text. Park and Hopkins (1993) classify these visuals into dynamic and static. They define dynamic visuals as the presentation of any type of pictorial and graphical movement during instruction, and static visuals as still pictorial images that do not change over time.

This study compared the learning that occurred as a result of instruction provided in a CBI format consisting of text supported by either static or dynamic visual displays. Much research has been conducted with static visuals, most of it prior to the advent of the computer screen. The use of dynamic visuals and animation are a much newer phenomenon. Even though a relatively new area of study, DVDs can draw upon a modest amount of research done in the area of visuals. According to Rieber (1990, p. 78), "Animated visuals are a subset of instructional visuals and . . . guidelines generated from the large body of research on static visuals extends to them". Although these dynamic visuals are similar to static visuals, they differ in certain aspects. As Dwyer (1978) points out, dynamic visuals have the ability to realistically portray an event, but the viewer loses control over the pace at which the visuals are presented. The viewer has to passively wait untill the dynamic visual is completed. Static visuals, having no viewing time interval, allow the viewer control over the viewing time, but lose the ability to realistically portray an event that requires motion.

This chapter discusses the research literature on instructional conditions under which visual displays can be used with learner-controlled instruction to support learning. With the focus on static and dynamic visuals, relationships among successful task completion, immediate recall, time, and computer confidence will be explored.

Use of Visuals in Instruction

Gagné (1985) identifies sixteen media choices that can be made to improve learning effectiveness. Eight are highly dependent upon visuals, three are supported by manipulatives, two make use of audio capabilities, and only three are exclusively textual.

Table 1: Instructional Media Choices

MEDIA	DELIVERY MODE
Portable Equipment	Tactile
Training Device	Tactile
Computer	Visual
Programmed Text	Text
Interactive TV	Visual
Motion Picture	Visual
Slide/Tape	Visual
TV Cassette	Visual
Filmstrip	Visual
Printed Text	Text
Training Aid	Tactile
Audio	Audio
Chart	Text
Overhead Projection	Visual
Slides	Visual
Instructor	Audio

Source: Data adapted from Gagné (1985)

Even with this variety of instructional choices, the printed text is the most frequently used by educators. This is a function of existing technologies and the maintainance of a traditional (and effective) language based instructional strategy; one in which, according to Sylwester (1991), the left hemisphere of the brain plays a major role.

If one agrees with See (1994) that we are entering a new information revolution heralded by the computer, then traditional methods of delivering information need to be examined to determine if there are other more effective methods, given the emerging technologies. With the broader adoption of new computer technologies, instructors need to revisit the visual learning modes to determine if they can be effectively used to improve the learning environment. Zavotka (1987), in discussing her study, states that, "Computer graphic animation can be a useful resource for the instruction of spatial skills"(p. 143). Rigney & Lutz (1976) used DVDs to elaborate verbal concepts and found that, "Supplementing verbal description with graphic analogies results in better learning and more positive student attitudes than presenting only verbal description"(p. 310). According to Alesandrini (1984), "Use of representational pictures is supported by the research and theory on the potency of visual memory and the importance of providing examples when teaching concepts"(p. 63).

Visuals have potential to aid in the learning process, but as Rieber (1990) warns, "Pictures also are helpful when they are highly related or congruent to textual material, but are distracting when unrelated, too complex, or superfluous (Willows, 1978)" (p. 79). Dwyer (1978) and Alesandrini (1984) also agree that to be effective, visuals must be used properly. If they are complementary to other communication forms, they are helpful, but they can have a negative effect on learning if they are too complex or in conflict with other instructional communication.

Computer Based Instruction

Computer based instruction (CBI) is a style of instructional delivery in which the subject receives instruction via computer, and CBI has the capacity to individualize the instruction. CBI begun in the early 1960's and there is literature to suggest that computer based individualized instruction is effective. Bloom (1984) claims that individualized instruction, specifically one-to-one tutoring, results in the greatest improvement in achievement. Kulik, Kulik and Cohen (1980) showed that the use of CBI results in increased achievement, and again Kulik, Kulik and Bangert-Drowns (1985) found that CAI-taught students had better retention, and that CAI improved the speed at which students learned a given amount of material. Clark (1992, 1994) discounts the advantages of media, and argues that media does not influence learning. He believes that most studies that found support the use of technology-based instruction were either poorly constructed, or the findings were the result of novelty.

Dynamic Visuals

The use of dynamic visual displays in a computer based instructional setting is a recent phenomenon. The power of computer technology is increasing, while the cost is decreasing, to the point, where the use of DVDs are becoming possible in an educational setting. Cost and power are some of the reasons that, as Rieber (1990) points out, "Very little research has been focused on practice strategies which involve and depend on animated displays and most of that research is quite recent" (p. 78). As the trend toward increasing power and decreasing cost of computer technology is making inclusion of computer visuals in an educational setting possible, the effective use of this potential requires exploration.

Usefulness of DVD in an educational setting is still being debated. Some researchers (Alesandrini, 1984; Alesandrini & Rigney, 1981; Rieber, 1991; Rigney & Lutz, 1976; Szabo & Pookay, 1995) have found significant improvements in learning with the use of DVD, while others (Doll, 1986; Peters & Daiker, 1982; Reed, 1985; Rieber, 1988) reported that DVD produced no significant change in learning.

Two researchers, one supporting visuals and one discounting visuals, point out the need for their effective use in any educational delivery mode. In support of visuals Molek (1984) states:

> The strategy of presenting visual and verbal information together has been shown to be effective for learning under a variety of conditions (Alesandrini, 1982). However, care must be taken when developing computer software that will take advantage of both forms of information rather than cause interference. (p. 9)

Rieber et. al., (1990) echo the same need for care in instructional delivery, but discount the use of dynamic visuals. According to them:

> Providing adults with animated presentations may be unnecessary to increase learning when given verbal presentations which are carefully designed with highly imaginable explanations and examples and when these students are prompted to form such internal images. (p. 51)

Both Molek and Rieber point out the need to attend to effective use of a media in instructional delivery. There is not only a question of whether DVD is useful or not, but also what is effective use of DVDs.

Learner Control

Milheim & Azbell (1988) describe learner control as the, "degree to which a learner can direct his or her own learning process" (p. 461) and found that learner control significantly improved long-term retention and attitude. Edwards, et al. (1975) found, "normal instruction supplemented by CAI to be more effective than normal instruction alone" (p. 147). They cite nine studies that showed CAI students achieving more than non-CAI students, eight finding no difference, and three with mixed results.

Instructional Conditions for Using DVDs

Park and Hopkins (1993) proposed six instructional conditions under which DVDs can be effectively used. The conditions are:

1. demonstrating sequential actions in a procedural task
2. simulating causal models on complex system behaviors
3. explicitly representing invisible system functions and behaviors
4. illustrating a task which is difficult to describe verbally
5. providing a visual analogy for an abstract and symbolic concept, and
6. obtaining attention focused on specific tasks or presentation displays.

They also point out that

> Research on the instructional roles of visual displays evolved out of two distinctive paradigms of learning theory: (a) a behavioristic paradigm which places primary emphasis on principles of associative and perceptual learning, and construction of learning conditions, using visual displays, eliciting necessary responses required in the task ... and (b) a cognitive paradigm that concerns cognitive structures and processes for explaining the network of verbal and visual representations. (p. 428)

Of the six instructional conditions suggested by Park and Hopkins, this study, in the opinion of the researcher, which guides the subject through the completion of a procedural task, focuses upon:

1. demonstrating sequential actions in a procedural task
4. illustrating a task which is difficult to describe verbally, and
5. providing a visual analogy for an abstract and symbolic concept

This study is also grounded in both the behavioristic and cognitive paradigms. The study is behavioristic, because it allows the subject to sequentially progress through the program, being cued by visuals that are associated to textual instructions, for the purpose of connecting the visual and textual clues to produce a specific response by the subject. By examining the successful completion of the task, this study concerns itself with the outwardly observable data, which is whether or to what extent the subject can replicate the procedural task.

The study is also cognitive in nature because it attempts to encourage the user, through the use of visuals, to attach meaning to programming instructions. The text instruction describes an action that the subject is to replicate. The visual provides another sensory input by displaying what the action looks like. By establishing links or associations between the text and visuals the study attempts to strengthen dual-coding capabilities of the user. This dual-coding should help the subject to connect words and images. This cognitive connection of verbal and visual is intended to increase the successful completion of a task. While the successful completion variable focuses upon outcome, the test of immediate recall focuses on specific and incidental learning that has occurred as a result of completing the set of instructions.

Park and Hopkins reviewed many studies comparing dynamic visual displays (DVDs) and static visual displays (SVDs). Table 2 combines their summary of these studies, along with some additions by this researcher, which use numbers one, four, and five instructional conditions.

These studies found no situation where dynamic visuals had a negative effect on the learning or where SVDs had a significant effect when compared to DVDs. In examining dynamic visuals they found mixed results ranging from non significance to significance. In ten studies that included the first instructional condition of demonstrating sequential actions in a procedural task, of which only three of which were CBI, seven stated that dynamic visual displays were significantly better while three showed no difference.

Table 2: Research summary of effects of dynamic versus static visual displays

Author & Year	Delivery medium	Psychological paradigm	Type of task taught	Instructional condition DVD used for	Significance of effect
Blake, 1977	Film/TV	Behavioristic	Cognitive skill (Movement rules of chess pieces)	1,4,6	For DVD partially
Laner, 1954, 1955	Film/TV	Cognitive	Short-term recognition (a series of pictorial stimuli)	1,6	No difference
Lumsdaine et al., 1961	Film/TV	Behavioristic	Cognitive Skill (Reading micrometer settings)	1,2,4,6	For DVD
Roshal, 1961	Film/TV	Behavioristic	Procedural Skill (knot tying)	1,6	For DVD
Spangenberg, 1973	Film/TV	Behavioristic	Procedural Skill (Disassembling machine gun)	1,6	For DVD
Silverman, 1958	Film/TV	Behavioristic	Procedural Skill (Load & dry-fire rifles)	1,6	For DVD
Swezey et al., 1991	Film/TV	Not Clear	Procedural Skill (Troubleshooting diesel engine)	1,4	No difference
Zavotka, 1987	Film	Cognitive	Conceptual understanding (Orthographic views)	2,4,5	For DVD
Alesandrini & Rigney, 1981	CBI	Cognitive	Concept learning (Chemistry concepts)	2,4	For DVD
Baek & Layne, 1988	CBI	Not Clear	Rule learning (Mathematical rule for averaging)	1,4	For DVD
Carpenter & Just, 1992	CBI	Cognitive	Conceptual understanding (Mechnical systems)	2,3,5	For DVD partially
Caraballo, 1985	CBI	Not Clear	Conceptual understanding (Function of human heart)	3,4	No difference

Table 2: Continued

Author & Year	Delivery medium	Psychological paradigm	Type of task taught	Instructional condition DVD used for	Significance of effect
Caraballo-Rios, 1985	CBI	Not Clear	Concepts & rule learning (Computation of polygonal areas)	4	No difference
Kaiser et al., 1985	CBI	Cognitive	Conceptual understanding (Trajectory of moving object)	4,5	For DVD
King, 1975	CBI	Not clear	Mathematical concept (Sine-ratio)	4	No difference
Mayton, 1991	CBI	Cognitive	Concepts & rule learning (Function of human heart)	3,4,6	For DVD partially
McCloskey & Kohl, 1983	CBI	Cognitive	Conceptual understanding (Trajectory of moving object)	4,5	No difference
Moore et al., 1979	CBI	Not clear	Conceptual understanding (Psycho-physiological ear function)	3,4	No difference
Peters & Daiker, 1982	CBI	Not clear	Concept Learning (Chemistry concepts)	2,4	No difference
Reed, 1985	CBI	Cognitive	Self assessment (Estimating time needed for math problem solving)	1,4	No difference
Reiber, 1989	CBI	Cognitive	Conceptual understanding (Newton's laws)	4,5	For DVD
Reiber, 1990	CBI	Cognitive	Conceptual understanding (Newton's laws)	4,5	No difference
Reiber et al., 1990	CBI	Cognitive	Conceptual understanding (Newton's laws)	4,5	For DVD
Reiber & Hannifin, 1987	CBI	Cognitive	Conceptual understanding (Newton's laws)	4,5	No difference
Rigney & Lutz, 1976	CBI	Cognitive	Concept Learning (Chemistry concepts)	2,4	For DVD
Szabo & Poohkay, 1994	CBI	Cognitive	Procedural Skill (Constructing Triangles)	1,4	For DVD

Source: Park & Hopkins (1993) plus additions

Twenty-one studies included the fourth instructional condition which was illustrating a task which is difficult to describe verbally. Three of the studies used film and/or TV as a delivery medium and eighteen used CBI. Of the twenty-one studies, eleven showed significant effect on learning when using DVDs and ten showed no significant difference in learning between the use of static and dynamic visuals. Seven studies included the fifth instructional condition of providing a visual analogy for an abstract and symbolic concept. Of the seven studies, four found a significant effect on learning by using DVDs and 3 found no significant effect on learning. Three of the studies were exclusively dedicated to instructional conditions one and four. One of those studies found DVDs to be significantly better while two found no difference.

Five of the studies, as does this study, involved the subject learning a procedural skill. Four showed that significant learning occurred with the use of DVDs, while one showed no significance. Although similar, because this study involves a procedural task, it is unique because the learning is separated into "chunks" (Reiber,1990). Also the subject demonstrates learning by replicating the task suggested after viewing each chunk of learning rather than after all the chunks have been presented.

Similar and Related Studies

This study explored the effect on learning as the result of CBI supported by static or dynamic visual displays. The effect of the visual treatment was determined by the variables of time, learner confidence, immediate recall, and task success. Other studies also focused on similar variables with varying results.

Studies that found DVDs to have a significant effect on learning were Baek & Layne, Zavoltka, and Mayton. Baek & Layne (1988) compared instructional effectiveness of three computer-assisted learning (CAL) modes: (a) CAL without any graphics, (b) CAL with still graphics, and (c) CAL with animated graphics to aid in learning the mathematical rule for average. Their results indicated that:

> The animation group scored higher than the graphics group as well as the text group (p < .05) while the graphics group scored significantly higher than the text group (p < .05). Results of the follow-up test on the time spent variable indicated that the animation group required significantly more time than the other two groups (p < .05). (p. 134)

Zavoltka (1987) also found support for the effectiveness of visual presentations produced by a computer-generated graphic animation systems as a teaching tool. In her study, subjects viewed computer-generated animated films depicting the rotation of solid and wire objects and were then tested on their ability to choose correct rotational and orthographical drawings. She states that, "This study clearly indicates that computer graphic animation can be a useful resource for the instruction of spatial skills" (p. 143).

Mayton (1991) studied dynamic visual support on text with static graphic instruction along with cueing strategies. He found that while the dynamic supported treatment group produced significantly higher scores, groups being cued to the learning produced significantly higher scores than groups not being cued, whether or not they received dynamic visual support. This led to questions about whether cueing or the dynamic visual was the determining variable.

> Both groups who experienced the imagery cue (animated and static graphics) significantly outperformed those who viewed the static visuals, no cue treatment form in the immediate testing session. This leaves some uncertainty as to whether the measured differences should be attributed to the inclusion of the animation or the presence of embedded cueing strategy. (p. 557)

Just as there is support for the use of visuals to improve learning, there is also research that discounts the use. Baek & Layne (1988) reviewed studies ((Doll, 1986; Peters & Daiker, 1982; Reed, 1985)) involving CBI and interactive graphics that found no significant difference in learning with the use of visuals.

Rieber (1988) compared text, static, and dynamic visuals in science lessons on Newton's laws of motion with elementary students. He found no significant differences in the learning of science concepts between dynamic and static visual presentations. However, the elementary school subjects took significantly less time to process lesson frames containing the dynamic sequences than similar frames containing static visuals or all text.

Rieber, et al. (1990) conducted a study similar to his 1988 study comparing text, static, and dynamic visuals on lessons involving Newtonian mechanics. This time subjects were university students. Again he found no significance and concluded "animation ... has little empirical support although it is widely incorporated into CBI as a presentation strategy"(p. 46). He also stated that in his study "No effects were found for Visual Elaboration: The addition of static and animated visuals to the text had no effect on learning" (p. 46).

Reed (1985) compared use of static and dynamic visuals to aid students in solving mathematical problems involving estimating speed, time, and mixture. Depending upon the group, students were shown either static or dynamic simulations of the problem and then asked to solve similar problems. In all three problem types Reed found no significant difference in the two delivery modes.

DVD and Different Classes of Learning Outcomes

Task Success

It is important to mimimize the time a learner spends in a learning experience, have the learner feel good about the experience, and have the learner acquire as much knowledge about the task as possible. Along with these goals, another highly important goal to achieve is having the learner actually successfully complete a task. In this study, the subject is presented with a procedural task to replicate. Success is defined as how closely the subject can replicate the series of tasks from memory because the subject is unable to view the instruction and perform the task at the same time.

Mayer (1975) conducted a study that made use of diagram models of familiar terms to create analogies between the models and computer programming to be learned. He found that students who saw analogical diagrams were better at interpreting programs while those who did not see the models were better at generating the program. This study did not make use of symbolic analogies to increase understanding but instead it uses visuals of the exact task to be learned to support the understanding of the task to complete.

Immediate recall

Krathwohl et. al., (1964) define knowledge as "recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting" (p. 186). Dwyer (1978), in interviewing high school and college instructors, determined that expected knowledge outcomes were to, "(a) learn terminology and facts basic to the course content, (b) identify locations and/or positions, (c) construct and/or understand relationships, and (d) engage in problem solving activities" (p. 44). This study's assessment of immediate recall fits both Krathwohl's definition and Dwyer findings. Subjects were asked questions both specific to the task of creating a title page, and questions universal to the APM program. They were asked to recall processes and patterns. They were expected to demonstrate knowledge of terminology and understand correct patterns and processes.

Many studies ((Alesandrini, 1984; Baek & Layne, 1988; Rieber, 1990; Rieber, 1991; Szabo & Pookay, 1995)) found a positive relationship between CBI, visuals, and the amount learned. Also Rieber & Kini's (1991) study involving multiple channels found that use of visuals increased probability of recall.

Time

Time in this study is defined as the time the subject uses to read the instructions and complete the task. CBI, through its ability to provide for learner control, allows the learner to vary sequencing of the instructional strategy and time spent in each instructional sequence. Edwards states that, "several studies have shown that even though CAI does not always result in greater achievement, the time it takes students to learn is reduced" (p. 149). Booher (1975) also supports this time advantage because, according to Rigney & Lutz (1976), evidence suggests that pictures facilitate speed of performance, while printed words aid accuracy of comprehension. Baek & Layne (1988), on the other hand, indicated in their study that while both static and dynamic visual groups scored higher than the text group, the dynamic visual group required significantly more time.

Computer Confidence

Packard et al. (1993) conducted a pilot study comparing attitude of subjects involved in three treatments consisting of (a) text, graphics and static interactions for testing (TGS), (b) text, graphics, and animated interactions (TGA), and (c) text, graphics, plus passive video (TGPV). Packard comments that subjects in the TGS module were less enthusiastic than subjects in the other presentations and subjects had a more positive attitude toward the animated and video interaction modules. The current study examined whether there is any difference in attitude with regard to computer confidence when assessing static or dynamic visual support with text based instructions.

Gressard & Loyd (1986) subdivided computer attitude into the characteristics of anxiety, confidence, and liking. Each division, while having the ability to provide information individually, is a component of computer attitude and when all components are combined produce an overall assessment of computer attitude. This study was only concerned with computer confidence because upon completion of the task, it focused on how confident the user felt about their ability to successfully complete the task.

To explore the variable of computer confidence, the computer confidence portion of the Computer Attitude Scale developed by Gessard & Loyd (1986) was used:

> The Computer Attitude Scale is a Likert-type instrument consisting of 30 items which present positively and negatively worded statements of attitudes toward computers and the use of computers. Three main types of attitudes are represented; (a) anxiety or fear of computers, (b) confidence in the ability to use or learn about computers, and (c) liking of computers or enjoying working with computers. In response to the statements, subjects choose one of four ordered responses, ranging from "strongly agree" to "strongly disagree," thus reflecting the extent to which they agree of disagree with the ideas expressed. (p. 295)

This scale has been used by many researchers (Liao, 1993; Woodrow, 1991, to name a few). Woodrow, in her comparison of four computer attitude surveys in referencing the Computer Attitude Scale found that:

> The reliability of the subscales and a factor analysis of their statements led Loyd and Gressard to suggest that the three subscales are sufficiently defined to be used as separate scores. (p. 167)

Positive learning experiences should result in increased confidence by the computer user. Degree of confidence should be an indication of how successful the subject feels in completing the assigned task.

Concluding Remarks

This study explores effects on time, computer confidence, immediate recall, and task success resulting from visually supported computer text instructions. The task to complete is proceduaral in nature and visuals are monochrome and realistic representations of the learning task. There exists research literature that shows visuals significantly improve learning and literature to show visuals have no effect. No studies were found that showed visuals to have a negative effect. Rigney & Lutz (1976) suggests an interesting view on this mixed support for use of visuals. They suggest that as we train students to learn we overemphasize the left hemisphere at the expense of the right. One reason for students not learning from visuals might be that they are not trained to learn from them. (Canelos,1979)

This study involves a procedural task which is separated into "chunks" (Reiber,1990). The subject demonstrates learning by replicating the task after viewing each chunk of learning. The delivery of instruction is in the same format (computer based) as the task to be replicated and the assessment of immediate recall.

Chapter III

Methodology

This chapter describes the purpose, hypotheses, sample, treatment, variables, instruments, and data collection process that was used in this study.

Purpose

The purpose of this study was to examine selected effects on learning of computer-generated dynamic visuals, compared with static visuals, when used to support computer text to instruct users in development of an Authorware Professional™ (APM) program designed to create a title page. More specifically, this study examined textual instructions supported by dynamic or static visuals in the development of a simple programing task and its effect on time, immediate recall, computer confidence, and success in completing the procedural task of designing a computer title page.

Hypotheses Examined

It was hypothesized that there would be no difference between static and dynamic visual support with respect to the dependent variables of success, immediate recall, time, and computer confidence in completing the procedural task.

The hypotheses that were examined in detail were:

- There is no difference in performance scores replicating a procedural task when the instructions are supported by static or dynamic visuals.
- There is no difference in scores of the static or dynamic visual supported groups on an assessment of immediate recall.
- There is no difference in the time spent learning and performing a procedural task with respect to static or dynamic visual support.
- There is no difference in computer confidence of users after learning and performing a procedural task that is supported by static or dynamic visuals.

Sample

Subjects were male and female students registered in computer courses in an urban school district. Grades ranged from 9 to 12. All eighty students in the computer classes, except one, volunteered to take part in the study.

Table 3: Gender and age demographics of treatment groups

	Gender		Age	
Treatment	Male	Female	12 to 15	16 to 19
Static	19	13	21	11
Dynamic	17	13	15	15

Students had a working knowledge of the Macintosh computer and some students had minimal prior knowledge of (APM™) but very little knowledge of object oriented programming according to their teachers. Computer classes involved in the study were chosen by the researcher through informal requests. Students in the course were given the option not to participate in the study or to withdraw at any time but were informed that they still had to complete two assignments in APM™ for the course instructor, one being to create a title page.

Treatment

Procedure

A pretest of the instrument was conducted with ten adult students registered in a university course for preservice teachers. six students were placed in the static treatment group and four in the dynamic treatment group. The data collection for two of the dependent variables, time and success, was not effective and had to be changed for the actual test.

Initially time was designed to track both the time spent in the CBI program and the time spent in developing the title page. This could only be done if the subject used the 'Jumpoutreturn' function of APM™ which closed the CBI program and registered the time. Some subjects used Macintosh multitasking capabilites to switch between the programs, not closing the CBI program and rendering the time data collection corrupted. The decision was made to leave the CBI program open and redefine the time variable to be the amount of time measured by the computer that the subject used to read and understand the instructions, plus the time the subject used to complete the procedural task.

The collection of the title page program was another identified problem with procedure. The APM™ Title Page program initially was installed on the hard drive with the APM™ software while all other data was written to a data file on a diskette in the disk drive. Upon completion of the task some subjects shut down the computer, took the diskette out of the drive and brought their data to the instructor. Because the title page assignment was on the hard drive and not on the diskette it became impossible to match the data. This problem was solved by placing the Title Page file on the diskette and opening it for the subject at the start of the treatment.

Figure 1 diagrams the procedure for the administration of the actual treatment. The subjects were given a short introduction to APM™ of approximetaly 15 minutes which included an explanation of the programming and workspace areas. They were also instructed how to switch between the APM™ Title page program and the instructions using the multitasking capabilities of the MacIntosh.

Subjects were instructed that after completing this 'title page' procedural task they would have to complete another APM™ assignment as part of their course work. This was done to motivate the subjects to learn the program. They were made aware of the fact that they were involved in a study and written permission (Appendix A) by them to be a part of the study was received. They were instructed that they had the option to withdraw at any time, but that they still had to meet the course requirements of completing an APM™ assignment.

Figure 1: Research Design

Subjects were randomly assigned to receive static or dynamic graphically supported instruction. After a short introduction of the tools needed to work through the assignment, subjects accessed a runtime APM™ program of text instructions supported by either static or dynamic visuals. The subject read the instructions, and if they chose, used the 'hot button' to view either the static or dynamic visual depending upon the treatment path they were in. The visual stayed on the screen for a finite length of time before returning to a text only screen. The length of time that the visual was on the screen was determined by the dynamic visual. The dynamic visual stayed on the screen for two seconds after it had finished before disappearing. The static visual for each instruction step was set to be on the screen the same length of time that the dynamic was on the screen. This time varied depending upon the instructional step and the length of the visual. The user could view the visual as many times as they wished. The program tracked if and how many times the user viewed the visual.

In completing the program the subject used the multitasking feature of the Macintosh to switched between the CBI runtime program and the APM workspace to complete their title page assignment. When the subject decided that they had completed the assignment to the best of their ability, the CBI program administered the computer confidence survey and a test of immediate recall. Upon completion of the testing, the subject saved the APM™ Title Page program, closed both the Title Page and treatment instrument programs and the diskette containing the Title Page program, and testing data was collected.

Time was measured by the computer from the time the subject started reading the instructions till the subject decided that they had completed all they could. The time, confidence survey, and recall test results were recorded by the computer in a data file generated by the computer on a 3.5 floppy diskette placed in the disk drive. The subject's title page assignment was stored on the 3.5 floppy diskette for assessment by the study administrator. The degree of success in completing the assignment was assessed according to predefined parameters (Appendix B) by the researcher, who is knowledgeable in the field of APM™ programming, and recorded on the subject's data file.

Because of the organization of school timetables there was a finite time for the subjects to complete the instrument. Subjects were given one and one half hours to complete the instrument. In pretesting of the instrument, this appeared to be ample time for the subjects in the pretest trials.

CAI Program

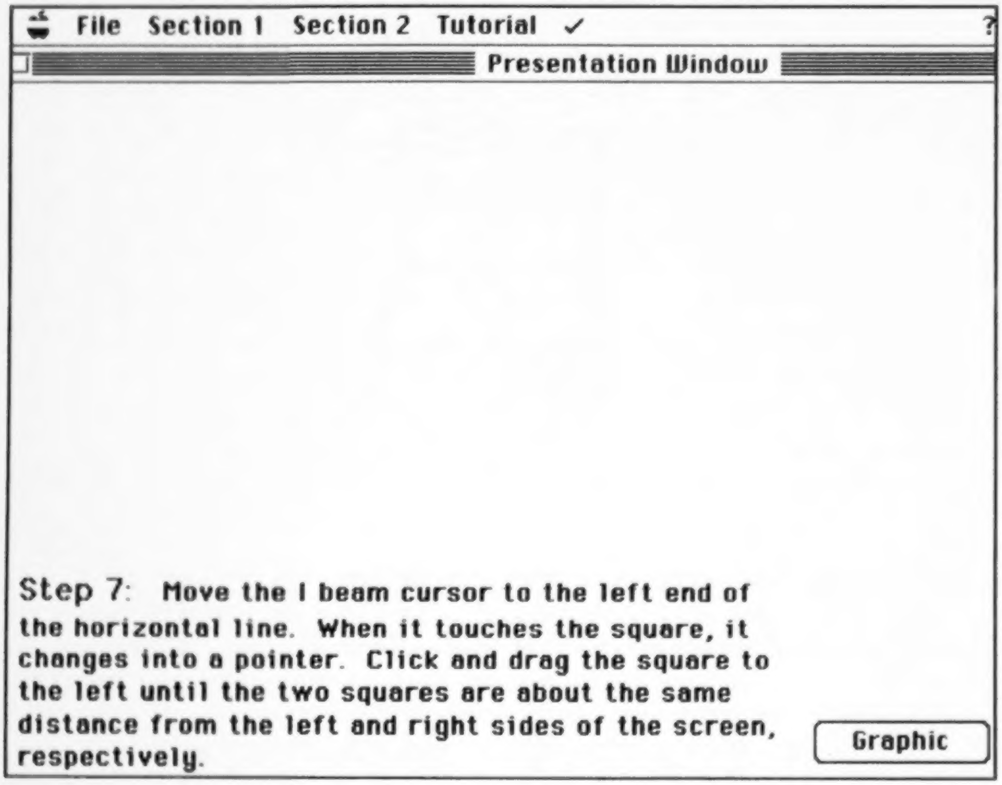
To test the hypotheses, two types of visual supports were created for the same self-directed, text based lesson designed to create a computer screen title page. The instruction to create a title page was derived from a paper-based tutorial on creating a title page. It is one of a series of eight tutorials developed by Professor Michael Szabo and used in this study by permission. Each treatment group had the same set of textual instructions with one group given static visuals for support and the other dynamic.

The dynamic visuals were created by performing an instruction while using Spectator software to capture the action and render it into a QuickTime™ movie. The static visuals were created by scrolling through the dynamic QuickTime™ movie and using Flash-it software to capture a static visual that best represented the essence that the dynamic visual portrayed.

In each situation, text with static visuals and text with dynamic visuals, the subject was presented with textual instructions. The 'static visual' group also had access to a static visual displaying the correct outcome for that instruction. The 'dynamic visual' group had access to a QuickTime™ movie sequence that created the correct outcome for that instruction. In both treatments the subject had the option to use or not use the visual support.

There were twelve separate instructions for the creation of the title page. Instruction one, to create a new file, was done for the subject to prevent unnecessary confusion in getting started. The first instruction required the user to open APM™ and create a new file Title Page. This step was done for the subject by the researcher to reduce confusion and to ensure that the Title Page data file would be saved to the data diskette. See Appendix C for the text instructions provided to create the title page. The thesis pocket contains the CBI runtime programs for both static and dynamic treatment groups in electronic version. In both CBI programs, each instruction was placed on a separate screen with a button that allowed the viewing of the visual support (static or dynamic) dependent upon the grouping that the subject was placed in.

Figure 2: Instruction Screen with Text Only



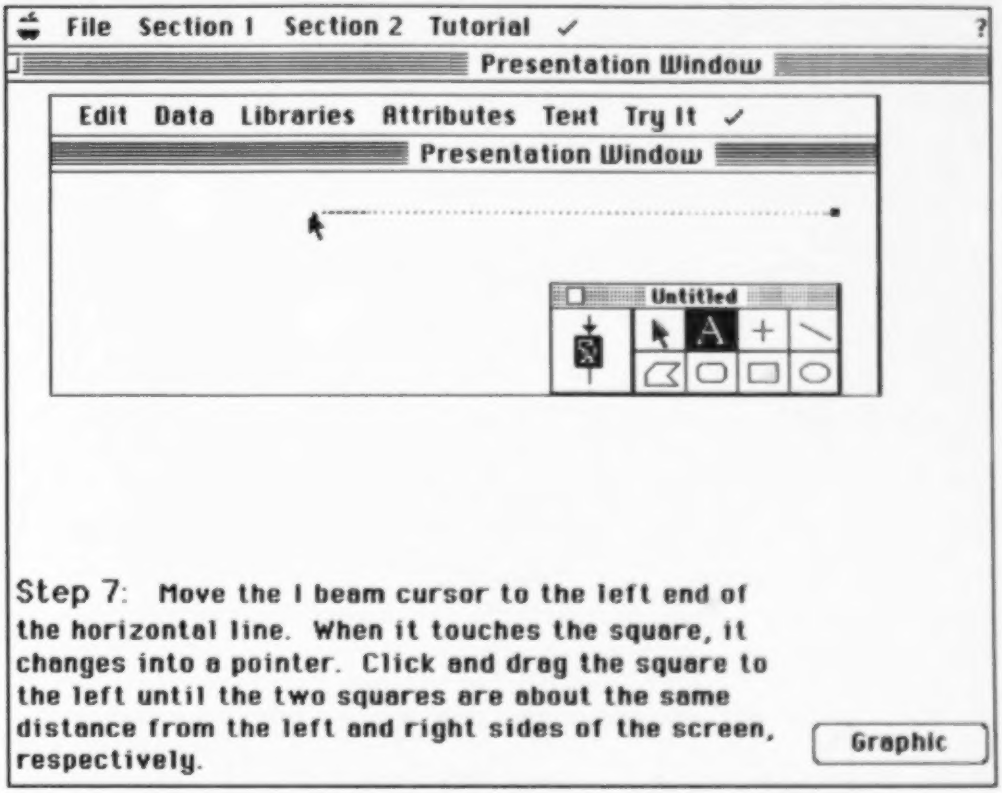
Step 7: Move the I beam cursor to the left end of the horizontal line. When it touches the square, it changes into a pointer. Click and drag the square to the left until the two squares are about the same distance from the left and right sides of the screen, respectively.

By 'clicking' on the hot button in the lower right corner the subject was able to view a visual display in either static or dynamic form that illustrated the instruction on the screen.

Using the menus the subject could a) view any of eleven instructions, (step one was done for the subject by the researcher) b) change to the APM program to work on their title page, or c) finish working and complete the confidence survey and recall test.

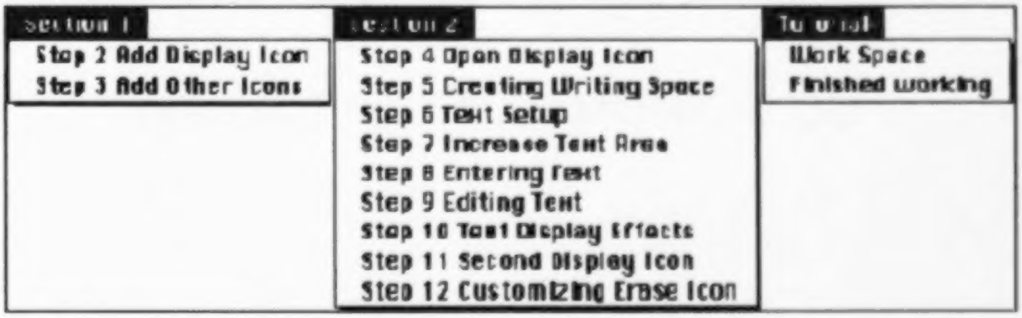
Using the multitasking functions of Macintosh's system 7, the subject could also move between the CBI instructions and the APM program at any time.

Figure 3: Instruction Screen with Graphic Support


File
Section 1
Section 2
Tutorial
✓
?
Presentation Window
Edit
Data
Libraries
Attributes
Text
Try It
✓
Presentation Window
Untitled
A
Graphic

Step 7: Move the I beam cursor to the left end of the horizontal line. When it touches the square, it changes into a pointer. Click and drag the square to the left until the two squares are about the same distance from the left and right sides of the screen, respectively.

Figure 4: Menu Options


Section 1
Step 2 Add Display Icon
Step 3 Add Other Icons
Section 2
Step 4 Open Display Icon
Step 5 Creating Writing Space
Step 6 Text Setup
Step 7 Increase Text Area
Step 8 Entering Text
Step 9 Editing Text
Step 10 Text Display Effects
Step 11 Second Display Icon
Step 12 Customizing Erase Icon
Tutorial
Work Space
Finished working

Equipment Requirements

Subjects each had their own computer. The minimum configuration of computer used to deliver the CBI program was a

Macintosh LC with a miminum of 4 megabytes of RAM memory and 20 megabytes of hard drive space. The operating system for the Macintosh was 7.1. APM™ student version, QuickTime 1.6, and APM™ quicktime drivers were also required. All software was resident on each individual hard drive.

The CBI program to deliver the instruction was developed using APM and packaged as a runtime version. Spectator 1.0 by Baseline Publishing, INC., is software that when activated captures activity that occurs in a defined screen space and renders what was captured into a QuickTime movie. It was used to create the dynamic QuickTime segments. Flash-it 2.2 by Nobu Toge, used to capture single frames of a defined area, was used to produce the static visuals.

Subjects used an APM™ student version to complete their title page assignment. The student version of APM allows for 50 icons of programming which was more than was needed. The runtime of the CBI instrument along with the APM student version allowed the computer to run the two programs at the same time, which was necessary to the study. The subject used the multi-tasking capabilities of Macintosh's system 7 to switch between programs.

Variables

In this study the independent variable was visual support which is defined as, and separated into, two components; static and dynamic visuals. The relationship of visual support and learning was assessed by examining four dependent variables.

The first dependent variable was degree of successful completion of the procedural task after the user determined that the task was completed to the best of his or her ability. The second dependent variable was amount of immediate recall regarding information about Authorware Professional™ for MacIntosh (APM) the user acquired by completing the programming task. This was measured using a 30 question multiple choice questionaire. The third dependent variable, time, was defined as the composite of the time it took the user to read and understand the instructions plus the time the user spent creating the title page program. The fourth variable was computer confidence as measured by the composite score on the computer confidence section of the Computer Attitude Scale developed by Gressard and Loyd (1986).

Instruments

Time

The computer measured the time that the subject spent in reading and understanding the instructions plus the time spent in creating the title page. Time started when the subject finished reading the general instructions and began reading the instructions to create a title page. It ended when the subject decided that as much as possible had been done, and chose to proceed to the confidence survey. The computer's internal time was used as the instrument to register time. Tests were conducted on random computers to check their internal clock against a stop watch. Time registered by the computers was found to be accurate.

Computer Confidence Survey

The computer confidence survey is a ten question four part Likert scale survey that is part of the Computer Attitude Scale (CAS) developed by Gressard and Loyd (1986). The ten questions from the CAS assess a subject's confidence in the ability to use or learn about computers. A higher score on this scale represents a higher degree of computer confidence. Each subscale of the CAS is reliable and has the ability to function by itself according to Woodrow (1991). This study was concerned with computer confidence so only the confidence subscale was used. See Appendix E for the 10 question confidence survey along with approval for use by Loyd and the complete survey.

Immediate Recall Assessment

The immediate recall assessment was a 30 item, multiple choice question test. The stems of the question are listed in Appendix E and the electronic form of the test is available in thesis pocket. The test consists of 15 questions that use static visuals as part of the question and 15 questions that use dynamic visuals as part of the question. Subjects completed all 30 questions, whether they were given static or dynamic support. Questions were presented to the students in random fashion making the sequence of question presentation for each subject different. The questions assess the subject's knowledge of APM™ both directly concerning creating the title page, and also other incidental knowledge the subject may have acquired as a result of using the program. The 30 questions were tested for reliability and the results are presented in Chapter IV. Validity was established by showing the test to Susan Ludwig and Dr. M. Szabo, both experts in the field of computers, and they agreed that the 30 questions tested the users knowledge of APM and the users knowledge of procedures and skills necessary to create a computer generated title page.

Success Assessment

The title page that the subject created was assessed by the researcher on a ten point scale. The researcher is an expert in the field of APM™ and is qualified to make competent assessments. Points were given for specifically replicating parts of the title page as shown in the instructions. Both design and presentation windows were considered. Transition effects were also assessed. No points were given if the part being assessed was not exactly as it was represented in the instructions. See Appendix F for the description of how the points were allotted. Assessment was made by the researcher without prior knowledge of which treatment the title page was created from. Little or no subjective judgement was required to assess the title page and all title page assignments were assessed by the same individual so the reliability of the instrument was expected to be high. Since the task to perform was a replication of the instructions, the instrument was expected to be valid.

Data Collection

At the start of the session subjects were given the consent form (Appendix A). The instructor went over the form with the students, had the form signed and collected. Data regarding demographic information, time, confidence survey, and immediate recall questions was collected electronically by the thesis instrument. As the subject responded to questions when completing the thesis instrument the response was recorded to an appropriate variable and written to a data file on the same diskette that contained the APM™ Title Page file. When the student finished working on the Title Page APM™ file he or she saved and closed the file which resided on the data disk. Later the researcher viewed and assessed the Title Page file according to parameters set out in Appendix B. The result was recorded on the subject's data file. All the data in the individual data files was combined for analysis.

Data Analysis

To test these hypotheses, mean and standard deviation were calculated for each of the dependent variables. Independent t-statistics and their corresponding 2-tailed significance were calculated to determine if there was significant difference between the two types of visual supports presented. A correlation matrix was developed to test for correlation between the dependent variables.

The immediate recall questions were divided into two groups of questions, one group which included static visuals in the question and another group that included dynamic visuals. A two way ANOVA with repeated measures on the questions was administered to test for significance between the two types of questions.

Chapter IV

Presentation of Results

Introduction

In this chapter results from data gathered are presented. Demographics of treatment groups are discussed. Reliability is reported by presenting the mean and corresponding standard of error for each variable within both the static and dynamic treatments. Independent t-statistics and their corresponding 2-tailed significance are calculated each variable. The significance level (α) for this study was set to 0.05.

Pilot Study

Data from the pilot study was obtained from ten adult students registered in a university education preservice computer course.

In the pilot study the data for the time variable was corrupt because of not taking into account the multitasking capabilities of the MacIntosh. The time was set to record when the used closed the instrument and opened the workspace. Multitasking allowed the subject to switch activities without closing making the data corrupt. Also data for successful completion of the task was not obtained because the data file and title page assignment were not kept in the same location and it was impossible to match the title page assignment with the subject's other data. The data collection of the other two variables, computer confidence and immediate recall was collected and is presented in Table 4. By inspection, the means of the two groups were quite different. This provided added justification for proceeding with the larger study.

Table 4: Mean and sd for dependent variables of pilot groups

	Static support (6 cases)		Dynamic support (4 cases)	
Variable	Mean	sd	Mean	sd
Recall	25.83	2.32	21.25	5.44
Confidence	36.33	3.27	30.25	5.85

Subject Data

Seventy-nine subjects were randomly placed into dynamic or static treatment groups. Nine subjects' data from the dynamic treatment group and eight subjects' data from the static treatment group were discarded due to incomplete data either as a result of hardware failure or the user declining to finish the treatment. Thirty-two subjects completed the static treatment and thirty subjects completed the dynamic treatment. Subjects were in grades 9 to 12 in two schools in a large urban centre.

Data was recorded to determine if the subjects made use of the visuals when proceeding through the instruction. The number of times that a subject viewed the visuals was recorded. One subject in the static treatment and two in the dynamic treatment made no use of the visuals. The mean number of visuals viewed by the static treatment group was 14.03 and the by the dynamic group the number was 15.01.

Reliability

The thirty questions used to test immediate recall were developed for this study. The mean and standard deviations of each item of the 30 item immediate recall test are displayed in Table 5. Cronbach alpha coefficient for the 30 item immediate recall post test was 0.84 based on the data acquired during the study.

Table 5: Immediate Recall Reliability Analysis - Scale (Alpha)

Item	Mean	STD DEV	Item	Mean	STD DEV
1	.80	.40	16	.32	.47
2	.77	.42	17	.61	.49
3	.75	.43	18	.65	.48
4	.23	.42	19	.69	.46
5	.69	.46	20	.89	.32
6	.68	.47	21	.52	.50
7	.19	.40	22	.15	.36
8	.52	.50	23	.71	.46
9	.73	.45	24	.42	.50
10	.82	.39	25	.61	.49
11	.60	.49	26	.63	.49
12	.21	.41	27	.23	.42
13	.79	.41	28	.73	.45
14	.29	.46	29	.45	.50
15	.94	.25	30	.50	.50

The attitude survey to assess confidence in the ability to use or learn about computers used in this study is a component of the Computer Attitude Scale developed by Gessard and Loyd (1986). The Computer Attitude Scale is a 40 item Likert-type questionnaire make up of four 10 question components. The four components are Computer Confidence, Computer Anxiety, Computer Liking, and Computer Usefulness. Woodrow (1992) compared four computer attitude scales, one being CAS. In studing the subscales of confidence, anxiety, and liking, she states the results of the three components are reliable and have the ability to be used by themselves. "The reliability of the subscales and a factor analysis of their statements led Loyd and Gessard to suggest that the three subscales are sufficiently defined to be used as separate scores." (p. 167-169)

The 10 statements used in this study are the same 10 questions that make up the Computer Confidence component of Gessard and Loyd's Computer Attitude Scale. Reliability was assumed based upon previous studies which found overall reliability on the subscales of confidence, anxiety, and liking to be 0.95 (Woodrow, 1992).

Hypothesis Analysis

The four null hypotheses tested in the study were:

- There is no difference in performance scores replicating a procedural task when the instructions are supported by static or dynamic visuals.
- There is no difference in scores of the static or dynamic visual supported groups on an assessment of immediate recall.
- There is no difference in the time spent learning and performing a procedural task with respect to static or dynamic visual support.
- There is no difference in the computer confidence of the users after learning and performing a procedural task that is supported by static or dynamic visuals.

For each of the four dependent variables: success, recall, time, and confidence their mean and standard errors for both levels of treatments are presented in Table 6.

The mean for time is expressed in one hundredth of an hour. The other three variables are based upon the raw scores allotted for that variable, 40 possible marks for the computer confidence survey, 1 mark each for the 30 question immediate recall test, and 10 marks allotted for the successful completion of the task.

Table 6: Statistics for dependent variables of treatment groups

	Static support (32 cases)			Dynamic support (30 cases)			t-test results		
Variable	Mean	sd	Se	Mean	sd	Se	t	df	p
Success	7.78	2.51	0.44	7.90	2.56	0.47	0.18	60	0.85
Recall	16.56	6.15	1.09	17.70	5.07	0.93	0.79	60	0.43
Time (hours)	0.63	0.20	0.06	0.68	0.16	0.03	1.11	60	0.28
Confidence	30.19	6.41	1.13	30.87	4.08	0.75	0.50	53	0.62

None of the differences between means achieved significance levels less than 0.05, hence all four null hypothesis were not rejected. There were no observed significant differences between static or dynamic visual support when comparing success, recall, time, and confidence in this research.

In further analysis of the data a correlation matrix was used to check for relationships between the four dependent variables. Results are presented in Table 7.

Table 7: Correlation of dependent variables

	Success	Immediate Recall	Time	Computer Confidence
Success		0.54 *	-0.20	0.34 *
Immediate Recall			-0.09	0.35 *
Time				-0.21
Computer Confidence				

* $p \leq 0.05$

There was a low correlation found between computer confidence and immediate recall and computer confidence and success. A moderate correlation was found between success and immediate recall.

Unanticipated Outcomes

The 30 questions used to assess immediate recall consisted of 15 questions that used static visuals and 15 questions that used dynamic visuals. Table 8 displays the mean and standard deviation each treatment group achieved in each group of 15 items and the combined mean scores for each group.

Table 8: Mean scores of treatment group to question type in Immediate Recall test

		Immediate Recall Questions					
		Static		Dynamic		Combined	
		Mean	sd	Mean	sd	Mean	sd
Groups	Static	8.72	3.14	7.63	3.54	16.56	6.15
	Dynamic	9.33	2.38	8.40	3.28	17.70	5.07
	Combined	9.02	2.80	8.00	3.41	17.11	5.64

The dynamic treatment group achieved higher mean scores overall and also higher mean scores in both the static and dynamic question groups. A two way ANOVA with repeated measures on the question was administered to test for significance between the grouping. The results are displayed in Table 9.

Table 9: ANOVA table of immediate recall questions

Source	Sums of Squares	d.f.	Mean Squares	F Ratio	Probility
Group	14.95	1	14.95	0.96	0.33
Within Group	939.50	60	15.66		
Questions	31.81	1	31.66	8.29	0.01 *
Group x Question Interaction	0.20	1	0.20	0.05	0.82
Question x Subject Within Group	230.30	60	3.84		

* $p \leq 0.01$

Both treatment groups did significantly better on questions using static visuals than dynamic visuals. There was no indication that either treatment group did better on a specific type of question.

Chapter V

Discussion of Results

Introduction

The purpose of this study was to compare static and dynamic visual displays used to support textual instructions provided to teach students how to perform a procedural task of creating a computer program. The two treatments studied were text supported by static visual displays and text supported by dynamic visual displays. In studying the treatments, the variables explored were successful completion of the task, immediate recall of knowledge about the program and task, time taken to complete the task, and computer confidence of the user.

Discussion is presented relating to each hypothesis made and is based on the results of the data analysis of the previous chapter. Implications of dynamic visual displays on computer based instruction are discussed along with recommendations for further research in this area.

Discussions

General

No difference was found for any of the four variables so in each case the null hypothesis was not rejected. Each variable will be examined individually but there may be some factors that affected the study as a whole.

Studies reviewed by Park & Hopkins (1993) plus additions by this researcher were cited earlier in Table 2. Of the eighteen studies using CBI nine studies showed significance for DVDs and nine no difference. This suggests that the evidence for DVDs is not overwhelming and may falsely appear to be effective. This study is consistent with the nine studies involving CBI and visuals that showed no difference between DVDs and SVDs.

There was a moderate correlation between success and immediate recall. There was also low correlation between computer confidence and both immediate recall and success. Although understandable, this might be an indication that these three measures may have measured similar variables or factors.

Hypothesis One - Success

The first hypothesis stated that there is no difference in static or dynamic visual support with respect to scores evaluating completion of the procedural task. Success was determined on a 10 point scale based on how closely the subject replicated the task. The students product was judged by the researcher based upon predetermined criteria without knowledge of which treatment was administered.

The static treatment group had a mean of 7.78 while the dynamic treatment group had a mean of 7.90. The difference of the means represents a increase for the dynamic group of 1.54% and was found not to be significant. The degree of simplicity of the task might have affected the degree of difference between the groups. The text instructions might have been sufficiently clear that subject did not need further explanation to complete the task. If the task was too simple, then both treatment groups could successfully complete the task with or without visual support, or the type of support was not critical to the completion of the task.

Another reason for no significant difference between the two treatments might have come from the design of the visuals. The static visuals were created by viewing the dynamic visual, finding the screen that best represented the essence of the instruction and capturing it to create the static visual. This made the two visuals similar, which would tend to lesson the difference between the treatments, and might also suggest that a well designed static visual is just as effective as dynamic one.

The advantage that CBI affords over other forms of instruction (Kulik, et al., 1980), along with CBI's ability to provide one-to-one tutoring, an effective form of instruction (Bloom, 1984), might explain the lack of a visual's ability to show significance. The task may not have been too simple but the inherent characteristics of CBI, regardless of visual support, might have allowed subjects to successfully complete the task. There might have been insufficient variance in the dependent measure for the type of visual to make a significant impact.

Coscarelli and Schwen (1979) studied alternative representations for a procedural algorithmic task. They compared prose, graphic flow charts, and lists as methods to deliver instructions to the subject. They found "there was no evidence that final grade was influenced by algorithmic representations". (p. 62) This lack of significance might help to confirm the findings of this study. The Coscarelli and Schwen study found that static visual support in the form of flow charts had no significance advantage over prose or lists. Instructions for the algorithmic task in this study were in the form of a list. If visual support produces no significant gain then it would not matter whether the visual support was static or dynamic which was the difference this study was exploring. Further research should include studying text alone to see if static and dynamic supports produce a significant difference from text alone.

Hypothesis Two - Recall

The second hypothesis stated that there is no difference in scores of static and dynamic treatment groups on assessment of immediate recall. Immediate recall was determined by subjects taking a 30 multiple choice question test administered by the computer. The equally weighted thirty test questions consisted of fifteen questions that used static visuals and fifteen questions that used dynamic visuals.

The static treatment group had mean scores of 8.72 on the static visual questions, 7.63 on the dynamic visual questions, and an overall mean score of 16.56. The dynamic treatment group had mean scores of 9.33 on the static visual questions, 8.40 on the dynamic visual questions, and an overall mean score of 17.70. Difference of the overall mean scores represents an increase for the dynamic group of 6.88% and was found not to be significant.

Both treatment groups scored significantly higher on the static visual questions than on the dynamic visual questions. There was no significant difference between the groups in how they performed on the complete immediate recall test. Also treatment groups did not differ by static or dynamic questions as evidenced by a non-significant treatment by question interaction.

If, as stated earlier, the task was too simple then subjects may not have attended to the visual display enough to acquire learning provided by the different type of visuals. This might explain why although subjects received results in the 77% to 79% range in successful completion of the proceduaral task, they only received results in the 55% to 59% range on the test of immediate recall.

Also the validity of the test could be reviewed. The immediate recall questions could be reviewed to determine if they adequately accessed the learning that occurred as a result of completing the CAI lesson.

Reiber (1989) found no significance when comparing static graphic, animated graphic, and no graphic instructional treatments. Hence, he attributed this to subject's lack of attending to elaboration strategies. This lack of effective cues for the subject to attend to the visual being presented might also explain the lack of significance in this study with respect to immediate recall. If subjects did not pay appropriate attention to the visuals then the visuals lose their ability to create a significant difference. In this study, the dynamic visuals used were separated into 'chunks' that exclusively replicated instructions given by individual CBI screens. Static visuals were stills that captured the essence of the instructions and were on the computer screen for the same time duration as the dynamic visual would be in the other treatment group. The subject would activate the visual by pressing a hot button in the lower right corner of the screen. Visuals appeared in the upper left or upper middle portion of the screen. Other than actively pressing the hot button there was no cueing of the visual or cueing important parts of the visual. Further study should be conducted to see if adding cueing would affect results.

Hypothesis Three - Time

The third hypothesis stated that there is no difference in static and dynamic visual support with respect to time spent learning and performing the task. Time was recorded in one hundredths of an hour and began when the subject began reading the assignment instructions of the procedural task and continued until the subject decided the task was complete and went on to complete the confidence survey and immediate recall questions.

The static treatment group had a mean of 0.63 hours while the dynamic treatment group had a mean of 0.68 hours. The difference of the means represents a increase for the dynamic group of 7.94% or

4.76 minutes and was found not to be significant. A spread of time did occur for individual subjects. The task time ranged from 12 minutes to 56 minutes, which is not out of the ordinary for student-paced instruction.

This lack of significance might also be attributed to the task being too simple, for a time spread between groups to occur. Another reason for this lack of completion time difference might be a result of the computers in the testing situation being side by side. When students saw other students finishing there may have been undue influence to finish. This knowledge of where other students are in the assignment should be eliminated in further research.

Hypothesis Four - Confidence

The fourth hypothesis stated that there is no difference in the static and dynamic visual support with respect to the confidence of the subject toward using the computer and learning a computer task. Confidence was determined on the results of a 10 question, 4 part Likert scale questionnaire where the top score is 40, and greater scores indicate increased computer confidence.

The static treatment group had a mean of 30.19 while the dynamic treatment group had a mean of 30.87. The difference of the means represents an increase for the dynamic group of 2.25% and was found not to be significant.

If there are no differences in success, time taken to complete the task, and immediate recall, it might follow that there should be no significant difference in computer confidence of the subjects. The reasons for this non significance would be similar to those for the previous three hypotheses. This argument, however, assumes a high intercorrelation among the variables. The data revealed this not to be the case. There was a low correlation between computer confidence and both success and immediate recall.

An alternative explanation is that the effect of visuals is intrinsically unrelated to confidence in use of a computer. Another feasible explanation is that computer confidence is a stable trait, built up over prolonged time and exposure to computers. One class of exposure to visuals, particularly in computers which make extensive use of the graphical use interface may have been insufficient to bring about a measurable change.

Factors Effecting Significance

One reason for non significance might be that 17 subjects' data was discarded due to incomplete data. This represents 21.5% of the subjects involved in the study. Data were considered incomplete when data for at least one of the variables were missing. This amount of incomplete data might indicate greater than acceptable problems experienced by subjects in understanding how to use the computer and associated software or in completing the assignment. Assessment of the instrument and procedures should occur to determine if adjustments can be made to improve the ease of use.

Lack of motivation of the subjects to complete the instrument might have been another reason for incomplete data samples. Students in junior and senior high school might be more interested in completing the instrument if there was some incentive. This lack of motivation to complete the instrument might be solved by giving an incentive to all subjects who complete the instrument. This, hopefully, would decrease the number of incomplete data points.

Another reason for no significance might be that there was a finite time for the subjects to complete the instrument. Subjects were given one and one half hours to complete the whole study. In pretesting the study, this appeared to be ample time. This time limit may have made some subjects finish the proceduaral task before they were ready and also to rush the confidence survey and immediate recall test thus effecting the data results.

The configuration of the rooms that the instrument was administered in might have affected the results. Computers were placed in close proximity in a side by side configuration. Subjects were accustomed to a cooperative learning strategy during their computer classes, but were monitored and instructed not to look at other computers and other subject's work. This problem might have effected the results. This effect of cooperative learning might explain why the data means for successful completion of the task was in the high 70% range while the data means for immediate recall of knowledge was in the mid 50% range. Immediate recall test presented the questions in random order for each student making it more difficult to share work. This side by side computer configuration might have affected time and success variables by introducing the variable of group pressure. Students may have seen other students finishing and then rushed the instrument in order to keep up with the group.

Another reason might have been that the task was too easy, not providing a necessary spread of results in the success completion of the task to show significance. With both treatments receiving mean scores above the 77% range the task to perform might have been too easy, allowing the subjects to successfully complete the task without having to intensely interact with the instructions and visuals. This ease of task might have not only effected success but also immediate recall and time.

Mayton (1991) in his study pointed out the importance of cueing the subject to the visual during the learning process. In this study the subjects had control of if, and when, to display the visual but the CBI program did not cue the subject to pay attention to the visual. This lack of cueing could be a reason for the lack of significance between the two treatments. A study to consider this question could involve four treatments using visuals; static, static with cueing, dynamic, and dynamic with cueing. Cueing should direct the subject the to important components of the visual either through the use of arrows or color.

Recommendations for Further Study

In assessing the current study the procedural task to perform appeared to be too easy. The study should be repeated with consideration given to using more sophisticated tutorials to ensure a greater range in the level of success. The time of the testing period should be increased and incentives for completion should be introduced. The study should be redesigned to allow group work that would take advantage of the cooperative learning nature of the computer class.

In the study the subject had control over which visuals to view. Visuals were on the screen for a specific amount of time and if the time was not sufficient the subject had to press the view option again. Data was compiled to determine that in all but three cases the visuals were used and the mean number of uses for the static group was 14.03 and the by the dynamic group was 15.01. Research should be conducted to determine which of the eleven instructions produced the greatest viewing of the visuals and which type of visual was viewed for each instruction.

Both treatment groups did better on significantly static visual based questions in the immediate recall component than dynamic based questions. Research should be conducted to see if the dynamic based questions were more difficult or if the questioning form (i.e. dynamic visuals questions) increases the difficulty of understanding and answering a question. Also, would training in answering questions containing dynamic visuals effect results.

Because there was no significance between static and dynamic visuals the study should be repeated with a third treatment of text alone. This would establish if the visuals, regardless of the type, have an effect.

Acknowledgement of the cooperative learning strategy used in the computer classes was noted. The effect of this cooperative learning strategy should be compared with environments that restrict cooperative learning. Another possible avenue of study involving cooperative learning would be to group students in two's or three's and compare the different visual treatments or the grouping size within a visual treatment.

Conclusion

Park and Hopkins (1993) summarized many studies involving static and dynamic visuals used to demonstrate sequential actions or to illustrate a complex task. They found mixed results with regards to significance of the use of dynamic visuals. This study also compared static and dynamic visuals by looking at the variables of success, immediate knowledge, time, and confidence and found no significant difference between static and dynamic visuals. The study did add to research practice by exclusively using a computerized instrument to instruct and assess subjects. It also added to the body of knowledge regarding visuals generated and displayed by a computer, along with suggesting many new avenues for additional research.

See (1994) stated that the computer is the next major communication invention that will significantly impact society. It will do this because it has the ability to provide easy access to large amounts of information in multiple formats. The computer's ability to communicate with the aid of visuals will impact the way we learn as a society. Most school based learning occurs in a textual form and appeals to the left hemisphere of the brain. It has been argued the use of visuals, which appeal to the right hemisphere, will not only change what we learn, but the way we learn, and possibly, who will be successful in the learning process. Understanding the impact of this new communication form is important to educators specifically, as well as society as a whole. Thus far, the numbers of studies supportive of DVDs is equal to those which are not supportive.

Neil Postman (1993) in Technopoly talks about the introduction of new technologies into a society. He says

> "Once a technology is admitted, it plays out its hand; it does what it is designed to do. Our task is to understand what that design is—that is to say, when we admit a new technology to the culture, we must do so with our eyes wide open" (p. 7).

He also suggests the introduction of computers is like introducing a new species to a forest. You never just add a species. When you do, the forest is changed forever. Computerized visual learning has the same potential. As we introduce computer visuals to the learning process, we have the potential to change that process forever. As Postman points out we must do it with our eyes wide open.

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Appendix A

Consent Form

Consent Form

Researcher: Ron Schlender, Graduate Student, Instructional Technology

Department of Adult, Career, and Technology, Faculty of Education, University of Alberta

Title of Thesis: Effects of Computer-displayed Animation and Static Graphic on Achievement, Time, and Confidence in Programming Instruction

By signing this form, I hereby agree to participate in the above mentioned research study. Having been contacted by the researcher, I understand that:

1. the purpose of this study is to examine the effects of animation and static graphics used in computer based instruction on learning outcomes.
2. my name is confidential and will not be disclosed at any time during this study, nor will it be used in the resulting thesis.
3. scores collected in this study will have no effect on my course grade and are confidential.
4. since my participation in this study is purely voluntary, I have the right to quit or stop participating at any time.
5. I may receive the results of the study from the researcher upon request.
6. I may examine the resulting thesis from this study by using the copy that will be available in the University of Alberta Library.

Printed name of participant ________________________________

Signature of participant ________________________________

Date ________________________________

Appendix B

Text Instructions

Tutorial #1: CREATING A SIMPLE TITLE PAGE

AUTHORWARE PROFESSIONAL (MAC)™ TRAINING SERIES

© 1994, Michael Szabo, All Rights Reserved

This Tutorial is designed for Authorware Professional (Mac), Version 2.0.1. In this tutorial you'll create a simple title page which includes the Lesson Title, author credits, and copyright notice. This tutorial is presented in step by step fashion. It is assumed you have a basic familiarity with the Macintosh and the use of the mouse. Tutorial #1 is the first in a series of training exercises for *Authorware Professional (Mac).* As you follow the steps, think through what you are doing for further application on your own.

Conventions used in this tutorial are as follows. Text which you are to type in is presented in *Italics.* Icon titles (after they have been typed) are enclosed in 'single quotes'. **Menu titles and commands** in the pull down menus or dialogue boxes are indicated in **Bold** text.To Select means to place the mouse cursor on an image and single click the button. To Open means to place the cursor on an image and quickly double click the button. To execute a command from the menu bar, Click and Hold the button on the menu title, Drag the cursor (which is now a vertical black bar) down to the desired command, and release the button. Keypresses will be denoted by capital letters as in "press the RETURN key. "Enjoy this tutorial.

SECTION 1. BUILD INSTRUCTIONAL STRATEGY - SELECTION OF ICONS

Step 2: Click and Hold the Display Icon in the palette at the left. Drag it onto the line on the blank screen and release. Notice word untitled is in reverse text. Type in the new name, *Title Page.*

Step 3: Next add a Wait Icon, another Display Icon, another Wait Icon and an Erase Icon. Name Display Icon as *Title Page 2* and Erase Icon as *Er Title Pages* .

SECTION 2: ENTER TITLE PAGE INTO DISPLAY ICON

Step 4: You are now ready to put the text into the title page. First, open the 'Title page' Display Icon by placing the mouse pointer on top of it and rapidly Double Clicking.

Step 5: You will see a blank screen with a small box with the words 'Title Page' near the top of the box. This is a Toolbox and allows you to select objects (pointer), enter text (A), draw horizontal/vertical lines (+), diagonal lines(\), polygons, rectangles, or round figures. Select (Single Click) letter A, the text tool. Note that the mouse cursor arrow has changed shape and is now an 'I' beam. Move the cursor to the upper left hand corner of the screen and Single Click.

Step 6: Move the cursor to the **Text** Menu, Click and Hold, drag downward until the **Font: Times** command is selected and release the mouse button.. This chooses the **Times** font. Now go to the **Style** menu and select in the same fashion, **Bold**, **Outline**; to **Justification: Center**, and **Size: 36 point** size. This will take 5 different actions.

Step 7: Move the I beam cursor to the left end of the horizontal line. When it touches the square, it changes into a pointer. Click and drag the square to the left until the two squares are about the same distance from the left and right sides of the screen, respectively.

Step 8: Now enter the text. You should see a large vertical blinking line midway between the two black squares. Type *MY FIRST AP LESSON* , followed by a RETURN keypress. Next type *BY*, followed by another press of RETURN, followed by *Your Name*, a RETURN, *Your Institution (company, school)* and RETURN.

Step 9: Place the I beam cursor on the left edge of the word BY, Click and Drag the cursor to the right and release. Notice the word BY has become reversed in shading (selected). If this did not happen, click anywhere on the screen and repeat. Now go to the **Style** menu and change the settings to **Bold** (only) and **14 point** size. Notice the change in the word BY.

Step 10: Click on the pointer tool (arrow) in the toolbox labeled "Title Page" and click once on the text. Select the **Attributes** Menu and the **Effects** command (see below). Set the effect to "Vertical Blind" and click OK. This will draw the text onto the screen using a vertical blind effect.

Step 11: Open the icon "Title Page 2" and type the text *©, 1994, All Rights Reserved* as shown on the next page. Use **Times** Font, Size **14**, **Bold**, and **Centred** (from the Text Menu). Type OPTION-G to create the © symbol.

Step 12: To erase the two display icons, select the **Run** command from the **Try it** menu. (Press RETURN when so directed). In the Erase Icon dialogue box that appears, select the Effect labeled **Barn Door Close.**

Single Click anywhere on the upper text, then single click on the lower text. As you do so, the text selected erases using the Barn Door Close effect and the icon erased appears in the lower part of the erase icon dialogue box

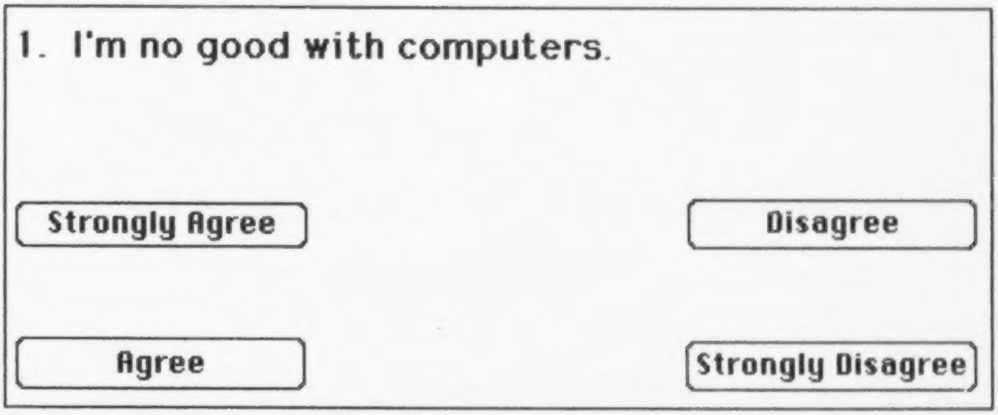
Your tutorial is now complete. To see how it works, select **Run** from the**Try it** menu.

Appendix C

Computer Confidence Survey

1. I'm no good with computers.
2. Generally, I would feel OK about trying a new problem on the computer.
3. I don't think I would do advanced computer work.
4. I am sure I could do work with computers.
5. I'm not the type to do well with computers.
6. I am sure I could learn a computer language.
7. I think using a computer would be very hard for me.
8. I could get good grades in computer courses.
9. I do not think I could handle a computer course.
10. I have a lot of self-confidence when it comes to working with computers.

Each question was displayed on the computer screen in the following format. The subject used their mouse to click on the appropriate response.



1. I'm no good with computers.

SURVEY OF ATTITUDES TOWARD LEARNING ABOUT AND WORKING WITH COMPUTERS

Brenda H. Loyd and Clarice P. Gressard
University of Virginia

The purpose of this survey is to gather information concerning people's attitudes toward learning about and working with computers. It should take about five minutes to complete this survey. All responses are kept confidential. Please return the survey to your instructor when you are finished.

Please check the blank which applies to you.

1. Age:
   ( ) 22 or less ( ) 23-25 ( ) 26-30
   ( ) 31-35 ( ) 36-40 ( ) 41-45
   ( ) 46-50 ( ) 51-55 ( ) 55+

2. College level completed:
   ( ) 1st year ( ) 2nd year ( ) 3rd year ( ) 4th year
   ( ) Bachelors ( ) Masters ( ) Doctorate

3. Major area of study: ______________________________

4. Sex: ( ) Male ( ) Female

5. Experience with learning about or working with computers:
   ( ) 1 week or less ( ) 6 months to 1 year
   ( ) 1 week to 1 month ( ) 1 year or more
   ( ) 1 month to 6 months

   Briefly state the type of computer experience: ______________________________

COMPUTER ATTITUDE SCALE

Below are a series of statements. There are no correct answers to these statements. They are designed to permit you to indicate the extent to which you agree or disagree with the ideas expressed. Place a check mark in the parentheses under the label which is closest to your agreement or disagreement with the statements.

	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
1. Computers do not scare me at all.	( )	( )	( )	( )
2. I'm no good with computers.	( )	( )	( )	( )
3. I would like working with computers.	( )	( )	( )	( )
4. I will use computers many ways in my life.	( )	( )	( )	( )
5. Working with a computer would make me very nervous.	( )	( )	( )	( )
6. Generally I would feel OK about trying a new problem on the computer.	( )	( )	( )	( )
7. The challenge of solving problems with computers does not appeal to me.	( )	( )	( )	( )
8. Learning about computers is a waste of time.	( )	( )	( )	( )
9. I do not feel threatened when others talk about computers.	( )	( )	( )	( )

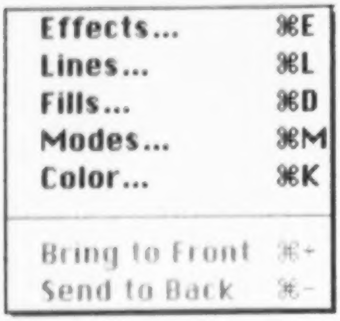
		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
10.	I don't think I would do advanced computer work.	( )	( )	( )	( )
11.	I think working with computers would be enjoyable and stimulating.	( )	( )	( )	( )
12.	Learning about computers is worthwhile.	( )	( )	( )	( )
13.	I feel aggressive and hostile toward computers.	( )	( )	( )	( )
14.	I am sure I could do work with computers.	( )	( )	( )	( )
15.	Figuring out computer problems does not appeal to me.	( )	( )	( )	( )
16.	I'll need a firm mastery of computers for my future work.	( )	( )	( )	( )
17.	I wouldn't bother me at all to take computer courses.	( )	( )	( )	( )
18.	I'm not the type to do well with computers.	( )	( )	( )	( )
19.	When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.	( )	( )	( )	( )
20.	I expect to have little use for computers in my daily life.	( )	( )	( )	( )
21.	Computers make me feel uncomfortable.	( )	( )	( )	( )
22.	I am sure I could learn a computer language.	( )	( )	( )	( )
23.	I don't understand how some people can spend so much time working with computers and seem to enjoy it.	( )	( )	( )	( )
24.	I can't think of any way that I will use computers in my career.	( )	( )	( )	( )
25.	I would feel at ease in a computer class.	( )	( )	( )	( )
26.	I think using a computer would be very hard for me.	( )	( )	( )	( )
27.	Once I start to work with the computer, I would find it hard to stop.	( )	( )	( )	( )
28.	Knowing how to work with computers will increase my job possibilities.	( )	( )	( )	( )
29.	I get a sinking feeling when I think of trying to use a computer.	( )	( )	( )	( )
30.	I could get good grades in computer courses.	( )	( )	( )	( )
31.	I will do as little work with computers as possible.	( )	( )	( )	( )
32.	Anything that a computer can be used for, I can do just as well some other way.	( )	( )	( )	( )

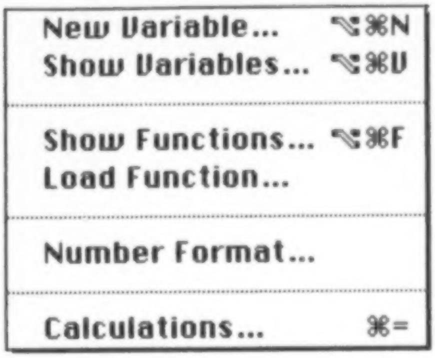
		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
33.	I would feel comfortable working with a computer.	( )	( )	( )	( )
34.	I do not think I could handle a computer course.	( )	( )	( )	( )
35.	If a problem is left unsolved in a computer class, I would continue to think about it afterward.	( )	( )	( )	( )
36.	It is important to me to do well in computer classes.	( )	( )	( )	( )
37.	Computers make me feel uneasy and confused.	( )	( )	( )	( )
38.	I have a lot of self-confidence when it comes to working with computers.	( )	( )	( )	( )
39.	I do not enjoy talking with others about computers.	( )	( )	( )	( )
40.	Working with computers will not be important to me in my life's work.	( )	( )	( )	( )

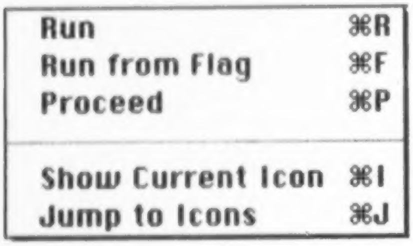
Appendix D

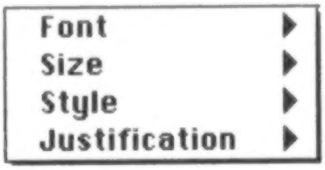
Immedicate Recall Assessment

1. Click on the Text menu.

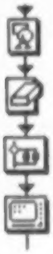

Effects... ⌘E
Lines... ⌘L
Fills... ⌘D
Modes... ⌘M
Color... ⌘K
Bring to Front ⌘+
Send to Back ⌘-


New Variable... ⌥⌘N
Show Variables... ⌥⌘V
Show Functions... ⌥⌘F
Load Function...
Number Format...
Calculations... ⌘=

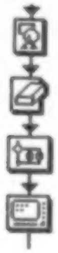

Run ⌘R
Run from Flag ⌘F
Proceed ⌘P
Show Current Icon ⌘I
Jump to Icons ⌘J

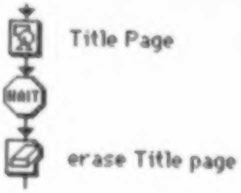

Font ▶
Size ▶
Style ▶
Justification ▶

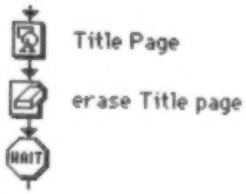
2. Click on the display Icon.

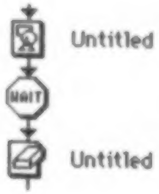


3. Click on the correct flow chart for displaying a Title Page and erasing it.

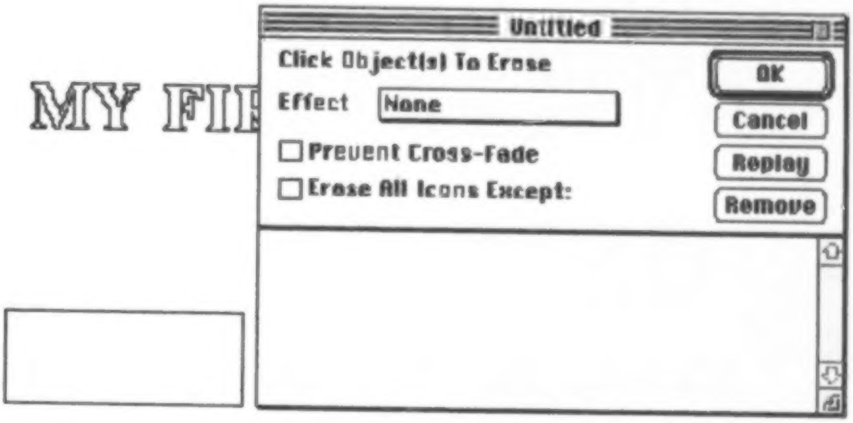



Title Page
erase Title page


Title Page
erase Title page


Untitled
Untitled

4. Which area must be clicked on to erase the text contents of the display icon?


MY FI
Untitled
OK
Cancel
Replay
Remove

Click Object(s) To Erase

Effect None

☐ Prevent Cross-Fade

☐ Erase All Icons Except:

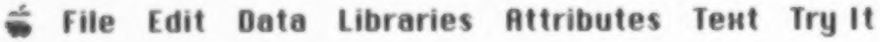
5. Click on the menu item one would use to paste objects.

File Edit Data Libraries Attributes Text Try It

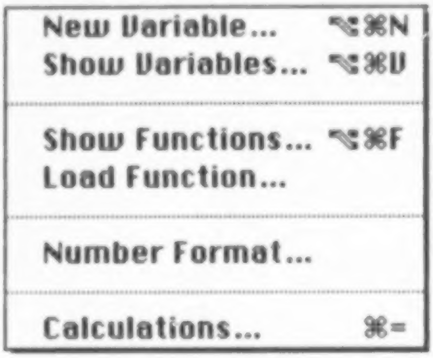
6. Click on the menu item one would use to run an Authorware progam.

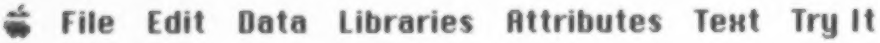
File Edit Data Libraries Attributes Text Try It

7. Click on the menu item one would use to change the color of the text in a display icon.

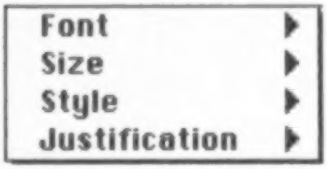

File
Edit
Data
Libraries
Attributes
Text
Try It

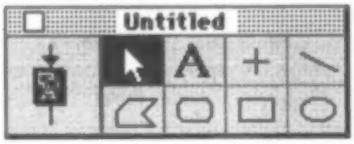
8. Click on the menu item one would find the following list.


New Variable... ⌥⌘N
Show Variables... ⌥⌘V
Show Functions... ⌥⌘F
Load Function...
Number Format...
Calculations... ⌘=

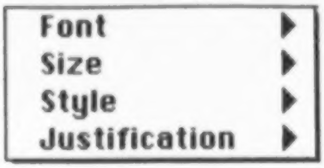

File
Edit
Data
Libraries
Attributes
Text
Try It

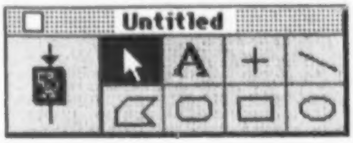
9. To enter text on the screen what item is essential to click on?


Font
Size
Style
Justification

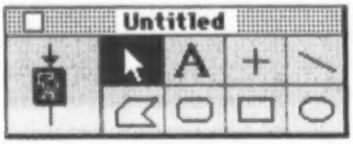


10. To centre text what item would you click on?

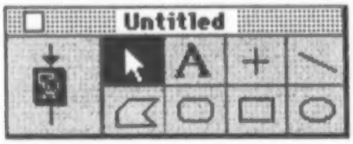

Font
Size
Style
Justification



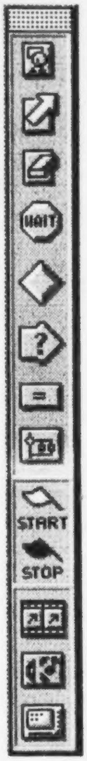
11. What tool from the toolbox would you click on to select an object in a display?



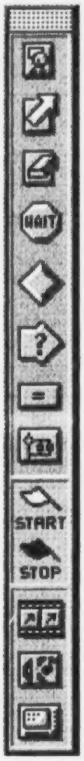
12. Where in the toolbox would you click on to return to the flowchart?



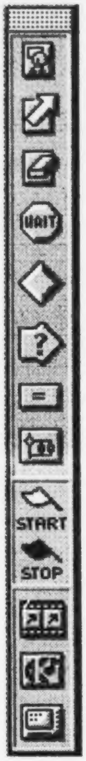
13. Click on the icon that causes your program to pause.


WAIT
START
STOP

14. Click on the icon that you can use to animate an object in a display.


WAIT
?
=
START
STOP

15. Click on the icon that erases contents of a screen.



16. Click and play the movie icons.

Movie A

Movie B

What is the correct order in initiating a new file?

A alone
A then B
B then A
B alone

17. Click and play the movie icons.

Movie A Movie B Movie C Movie D

Which movie is the initial step in making text bold?

CHOICES

A	B	C	D

18. Click and play the movie icons.

Movie A Movie B Movie C Movie D

Which movie is the initial step in having even text on the right side of the page?

CHOICES

A	B	C	D

19. Click and play the movie icons.

Movie A Movie B Movie C Movie D

Which movie is the initial step in changing the text from Geneva to Chicago?

CHOICES

A	B	C	D

20. Click and play the movie icons.

Movie A   Movie B

Which movie is the correct procedure for changing the word "BY" to 14 point size?

CHOICES

A	B

21. Click and play the movie icon.

Movie

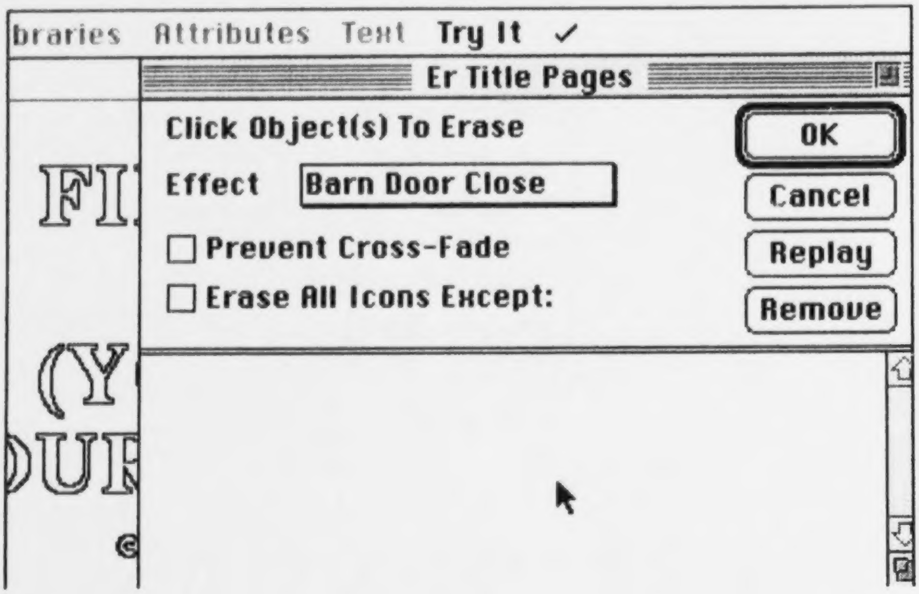
Which menu item would you access to reproduce the following movie?

** File Edit Data Libraries Attributes Text Try It**

22. Click and play the movie icon.

Movie

After watching the movie what is the next area you would click on?


braries
Attributes
Text
Try It ✓
Er Title Pages
OK
Cancel
Replay
Remove

Click Object(s) To Erase

Effect Barn Door Close

☐ Prevent Cross-Fade

☐ Erase All Icons Except:

23. Click and play the movie icons.

Movie A　Movie B　Movie C　Movie D

Which movie chooses a display icon?

CHOICES

A	B	C	D

24. Click and play the movie icons.

[Movie A] [Movie B] [Movie C] [Movie D]

Which movie chooses an animation icon?

CHOICES

A	B	C	D

25. Click and play the movie icon.

[Movie]

Click on the menu item one would choose to initiate the following movie.

🍎 File Edit Data Libraries Attributes Text Try It

26. Click and play the movie icon.

[Movie]

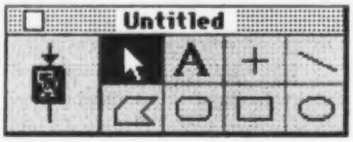
Click on the menu item one would choose to initiate the following movie.

🍎 File Edit Data Libraries Attributes Text Try It

27. Click and play the movie icon.

Movie

Which tool in the toolbox would you use to construct the figure in the movie?



28. Click and play the movie icons.

Movie A　Movie B　Movie C　Movie D

Which movie is the correct flowchart for having two display screens to appear separated by a pause?

CHOICES

A	B	C	D

29. Click and play the movie icons.

Movie A　Movie B　Movie C　Movie D

Which movie is the correct flowchart for erasing the first display screen before the second appears?

CHOICES

A	B	C	D

30. Click and play the movie icons.

Movie A   Movie B   Movie C   Movie D

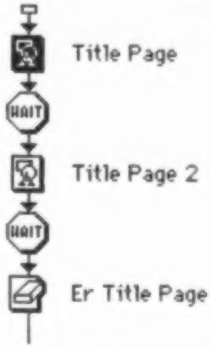
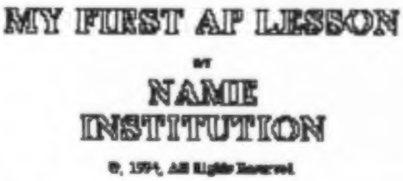
Which movie is a flowchart that is not possible?

CHOICES

A	B	C	D

Appendix E

Title Page Success Assessment

Assessment Focus	Description	Mark
Design Window		
 Title Page WAIT Title Page 2 WAIT Er Title Page	1. Correct flowchart 2. Icon names	1 3
Presentation Window		
MY FIRST AP LESSON BY NAME INSTITUTION ©, 1994, All Rights Reserved	3. Layout 4. "MY..." format 5. "BY" format 6. "©, 19..." format	1 1 1 1
Transition Effects		
Vertical Blind	7. T. Page 1 to T. Page 2	1
Barn Door Close	8. Erase of T. Pages	1
	Total	10

Thesis Pocket Explanation

Electronic Instrument

The thesis pocket contains three computer diskettes found in the enclosed thesis pocket. The 'Thesis Instrument' diskette contains in self extracting form electronic copies of both DVD and SVD CBI lessons in APM and packaged runtime form along with associated DVD as Quicktime movies proceduced with Spector software. It also contains the program used to assess the immediate recall and computer confidence variables in both APM and packaged runtime form. The diskette is compressed in a self expanding file.

UNABLE TO FILM MATERIAL ACCOMPANYING THIS THESIS (I.E. [✓ DISKETTE(S)], SLIDES, MICROFICHE, ETC...).

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INCAPABLE DE MICROFILMER LE MATERIEL QUI ACCOMPAGNE CETTE THESE (EX. DISQUETTES, DIAPOSITIVES, MICROFICHE (S), ETC...).

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